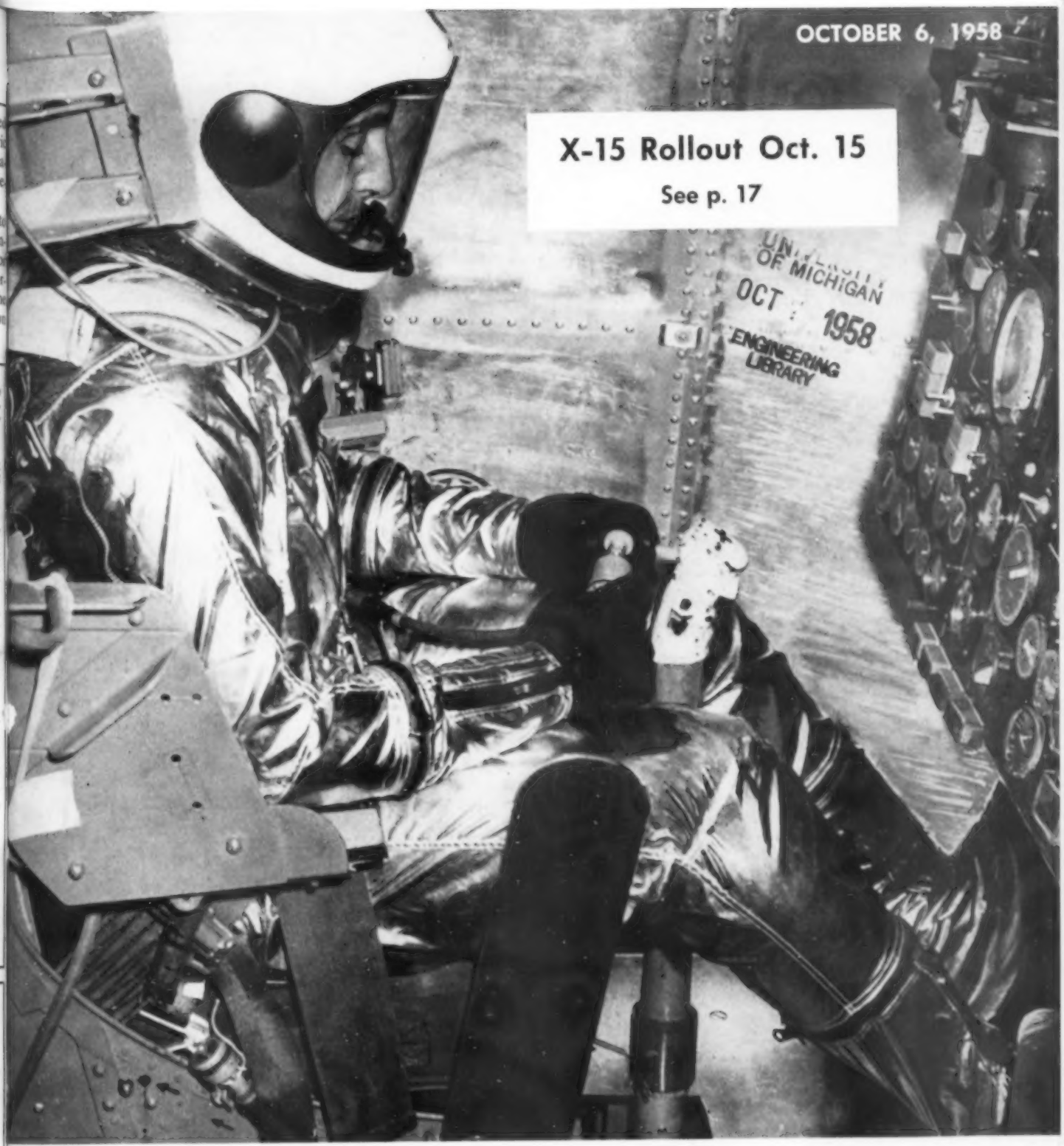
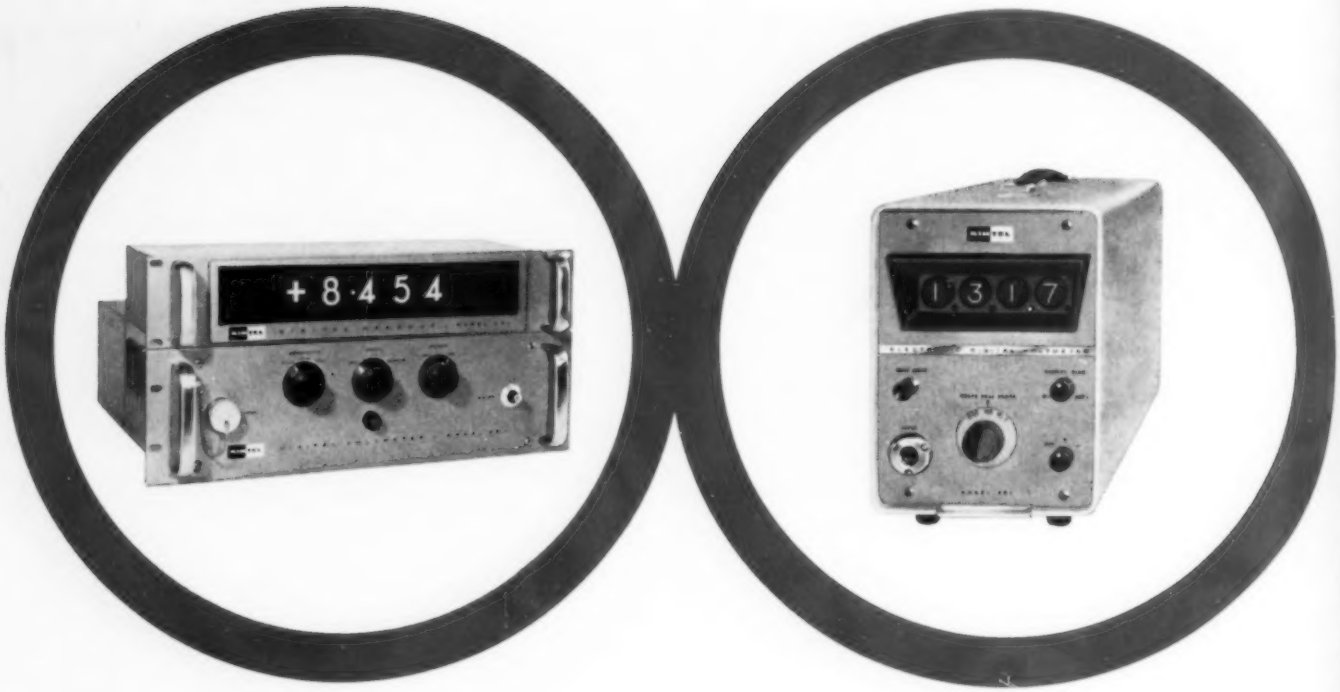


missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

Engineering and Electronics Edition

AN AMERICAN AVIATION PUBLICATION



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COVER: *Scott Crossfield, North American's test pilot for the Air Force X-15, is shown in a simulated cockpit of the rocket research craft in one of the many tests that have been conducted during the development program. The first of three X-15s is scheduled to roll out of the Los Angeles Division's fabrication shop Oct. 15 (see page 17). First powered flights are scheduled for Spring of 1959.*

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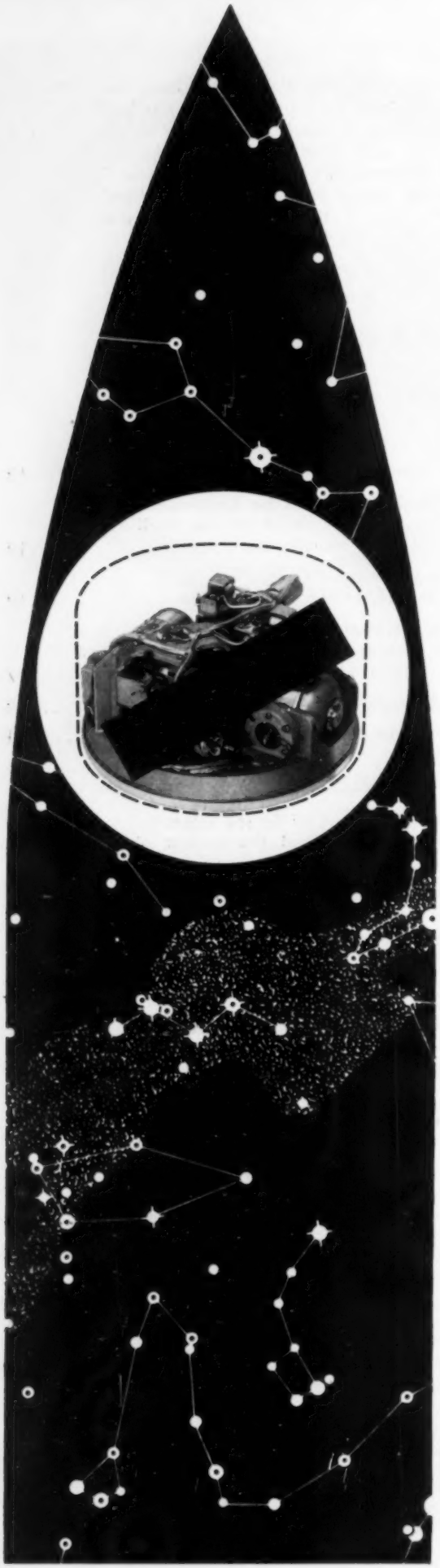

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Clary Gyros

The Clary CD 600 electrically driven amount gyroscope is a self-contained, three-gyro package consisting of three gyros mounted on a single bracket with pick-offs between the outer gimbals and the frame. It may be used either to control flight, or to transmit changes in pitch, yaw and roll attitudes. The entire unit is hermetically sealed and filled with dry helium. To withstand high acceleration and extreme vibration, and to insure maximum reliability, the CD 600, like all Clary gyros, is ruggedly designed, precision-manufactured and extensively tested.

GENERAL SPECIFICATIONS

Weight: DC system, 19.25 lbs.; AC system, 15.0 lbs.
Pick-off: Potentiometer or synchro.
Power Requirements: 27 V DC; 115 V AC.
Vibration: 10g at 20 to 2000 cps. • Warm-up Time: 2 minutes maximum.
Gimbal Freedom: Outer gimbal, 360° (continuous); inner gimbal, ±85°.
Drift Rate: Scorsby test .5° per 5 minutes.
Caging Operation: Remote electrical caging and uncaging control.
Temperature: −30°F to +160°F. • Altitude: No effect on operation.
Humidity: No effect on operation. • Size: Diam. 10", depth 6⅜".

The Clary CD 750 electrically driven amount gyroscope is primarily designed to control attitude of short range "artillery type" missiles such as the Corporal, Sergeant and others within the 500 mile range, where vibration and steady state accelerations are moderate to heavy. Separate pick-offs are provided for each axis, and the instrument incorporates a DC solenoid-operated caging mechanism to orient the gimbals with respect to the mounting surface. Internal atmosphere is −75° F dew point nitrogen with helium tracer at a pressure of 15 p.s.i.a.

GENERAL SPECIFICATIONS

Weight: 5 lbs. • Pick-off: Potentiometer or synchro.
Power Requirements: 115 V line to line, 400 cps, 3-phase power.
350 ma starting current, 70 ma running current.
Vibration: 10g at 20 to 2000 cps. • Warm-up Time: 2 minutes maximum.
Gimbal Freedom: Outer gimbal, 360° (continuous); inner gimbal, ±85°.
Drift Rate: Scorsby test. *Heavy rotor:* .5° per 5 minutes.
Light rotor: .5° per minute.
Caging Operation: Remote electrical caging and uncaging control.
Temperature: −30°F to ±160°F. • Altitude: No effect on operation.
Humidity: No effect on operation. • Size: Diam. 4$\frac{3}{16}$", depth 5$\frac{13}{16}$".

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industry countdown

"Fantastically close tolerances . . ."
are being called for in construction of the 5-foot-diameter aluminum sphere for the WS 117L reconnaissance satellite. Some industry representatives are beginning to express concern over how quickly our space-age requirements are advancing, in contrast with the slower pace of what is possible.

A place on the N.Y. Stock Exchange...
is being reserved for Thiokol Chemical Corp., according to informed Washington brokers. Thiokol, which has produced all successful *Polaris* engines to date, is the only officially-listed supplier for *Bomarc* boosters.

Missile money for small business . . .
is still the aim of many Congressmen, some of whom are pressing for immediate appointment of an official in the Pentagon Research and Engineering Office for the purpose of stepping up small business participation in missile programs. A report by the Subcommittee on Government Procurement of the Senate Small Business Committee says that Missile Director William Holaday has displayed a "disappointing lack of appreciation made to our defense effort by smaller firms in the past."

A large beryllium R & D contract . . .
has been let by the Air Force to the Beryllium Corp. in an effort to obtain a method for producing ductile castings of the metal. Beryllium, which USAF uses in its nose cones for ballistic missiles, has heretofore been available in machined form only after a lengthy, costly process. The final cost of the metal is expected to be reduced if the research is successful.

A 50-nation distribution net . . .
has been acquired by Litton Industries through its purchase of Westrex Corp., a subsidiary of Western Electric Co. Westrex will distribute Litton communication equipment, radar antennas, and other products. Gross income for Westrex in 1957 was $13 million.

Biggest U.S.-sponsored . . .
technical meeting ever held was the fourth annual Military-Industry Packaging and Handling Symposium, Sept. 30-Oct. 2 in Washington. Divided into 18 panels, those attending heard more than 130 speakers.

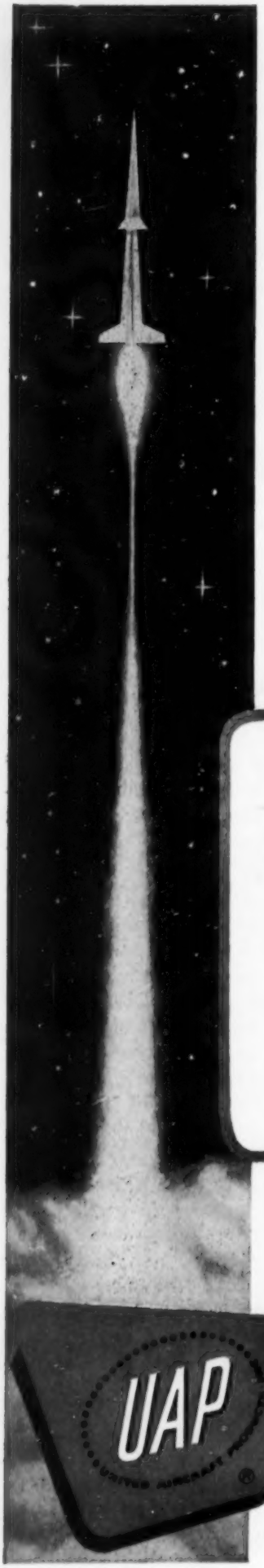
Purchase of Gruen Electronics . . .
division for $1½ million has been completed by Divco-Wayne Corp. of Richmond, Ind. The sale marks the entry of Divco-Wayne, makers of specialized vehicles, into the missile electronics market. Divco-Wayne had sales of $28 million in 1957, and employs 624.

A wage increase . . .
of 3% has been granted Servomechanism's Inc. 1100 employes. SMI indicated that the increase was part of a policy of maintaining its wage levels above the industry average. The boost, effective August 4, excludes those earning more than $15,000 annually.

A share of *Bomarc* production . . .
is what the Canadian government is seeking in order to offset the effects of the Avro CF-105 cancellation. Discussions are expected to be held with Boeing and the U.S. government on the best way Canadian industry may share in *Bomarc's* production. The Avro *Arrow* and *Sparrow* II were cancelled simultaneously. Avro employs 11,000.

European-made missile parts . . .
will not be bought by USAF, according to AMC's General Rawlings. This apparently rules out foreign licensing of either *Thor, Atlas* or *Jupiter* components. It does not, however, entirely preclude the purchase of some ground support equipment in England or the continent under the AF offshore procurement program.

$135 million *Nike-Zeus* contract . . .
for research and development of the anti-missile missile has been awarded by Army to Western Electric, N.Y. Douglas Aircraft and Bell Telephone laboratories are major subs.



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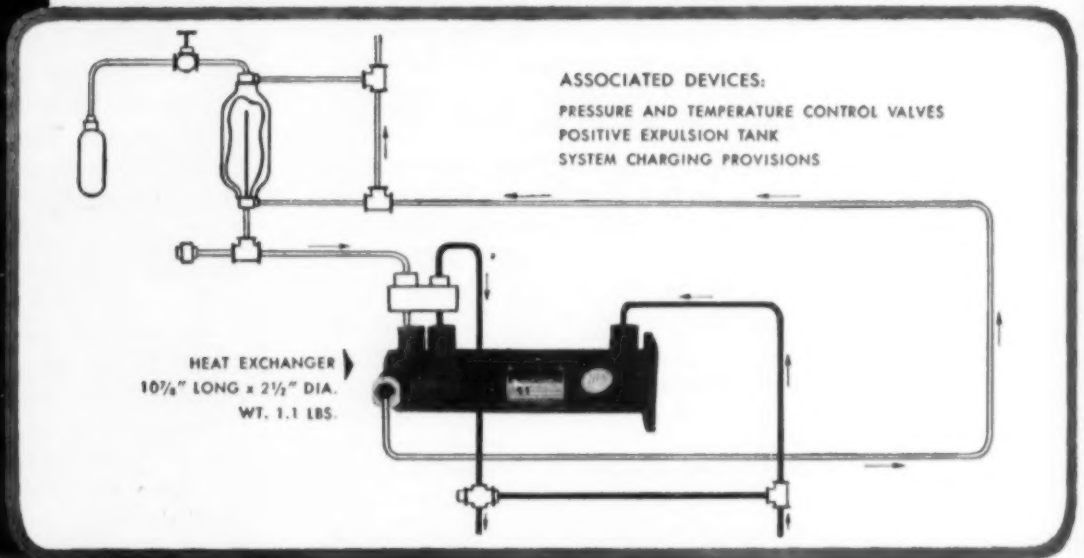

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washington countdown

Mathematicians, not generals . . .
will staff SAC's new Missile Trajectory Center, which will be something of a counterpart to the command's great communications and bomber control center at Offut AFB, Omaha. Purpose will be to calculate vast numbers of trajectories for ballistic missile squadrons.

Far from dead . . .
is AF's anti-missile Wizard program. In addition to the detection phase—which AF was authorized to continue—research goes on into certain other facets. Wizard—with Convair as contractor—is based on area-defense concept, as opposed to Army's point-defense theory. Some extra, but limited, AF funds are possibly being provided.

***Minuteman*'s first stage . . .**
developing 135,000 lbs. of thrust for 45 seconds, was static-fired for the first time last week by Thiokol, at Redstone arsenal (though it hasn't been officially confirmed by DOD). Early firing should mean considerable shortening for the weapons system. Second stage, which had a reported propellant weight of 37,000 lbs., has a 6½ ft. diameter, and is 27 ft. in length. Prime contractor for *Minuteman* will be named, and contract awarded, within 60 days. Some 30 proposals have been entered.

First space warfare . . .
won't be within possibility until USA and USSR have capability of putting offensive spacecraft over each other's territory, according to Gen. Thomas Power, SAC commander. Such craft are not yet "anticipated," he added. But just how far thinking has gone along these lines was also reflected at AFA meet in Dallas (where Power spoke) by Dudley C. Sharp, assistant AF secretary for materiel. Said Sharpe: AF will become space force in time, and AF interest in space operations is only so far as a military application is concerned.

US equatorial launching sites . . .
depend, at the moment, on allocation of responsibility for such satellite orbiting programs. Logically, this responsibility would go to NASA. Possibilities for location include Christmas Island, or equatorial South America or Africa. Estimated cost: site, $100 million; vehicle, $100 million.

First operating test *Titan* . . .
is expected to be accepted by AF any day now, with initial firing possible this month (see p. 17).

***Atlas* ICBM is now . . .**
air transportable. By removing forward section, missile can be packed into turbojet C-133.

The missile-carrying B-58 . . .
is probably more solidly in the Air Force inventory today than ever before, although certainly not secure. Reasons: tough Vice Chief of Staff General LeMay likes it better and better, and, equipped with the MB-1 atomic air-to-air rocket, it looks good as a long range interceptor.

Naval Research Lab . . .
is convinced that SLV-3 made at least two orbits of the earth before plunging back into the earth's atmosphere. A pick-up was made at the Antofagasta, Chile, minitrack at a time that would coincide with a second revolution. Although a station in South Africa reported sighting what they believed to be the satellite a few hours after launch, NRL firmly believes the ball fell after a maximum of three or four orbits.

Military Weather Satellite . . .
prime contract has been given Radio Corporation of America's Astro-Electronics Products Division, Princeton, N.J. Project is under managerial control of Advanced Research Projects Agency, but official DOD confirmation of the award has not been made. Air Force probably is cognizant service, but launch vehicles (modified *Jupiters*) may be supplied by Army Ordnance Missile Command. Less than six instrumented satellites are involved at this stage.

Note—Commercial and Military Packaging Engineers:

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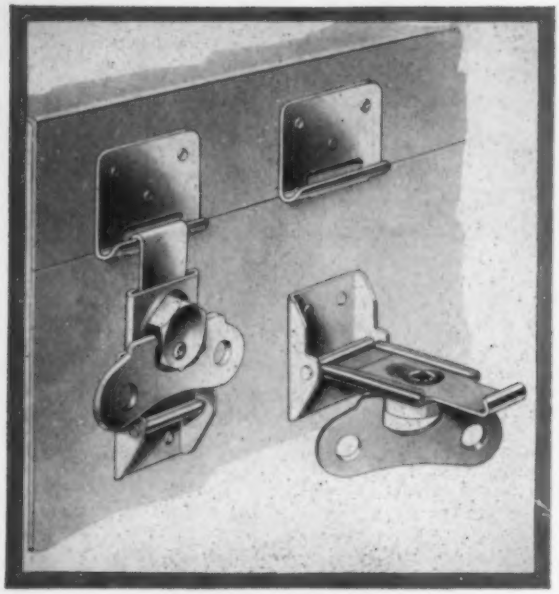

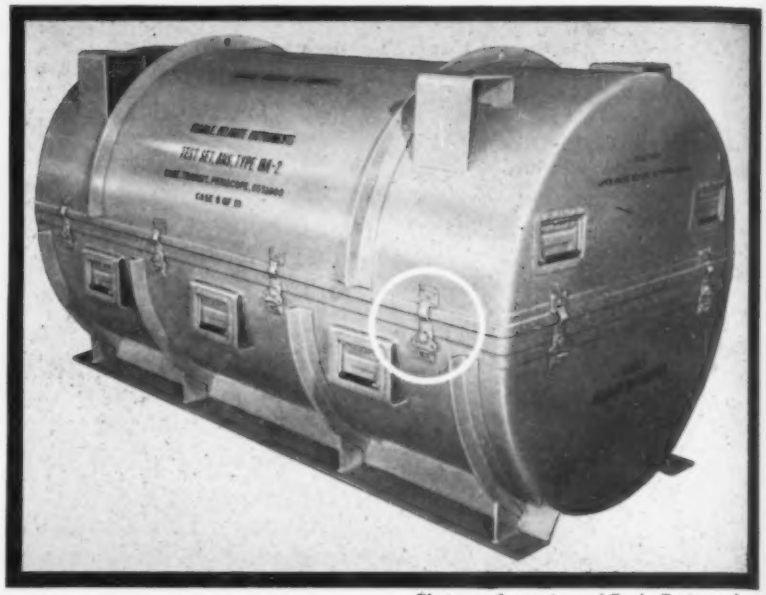

Photograph courtesy of Craig Systems, Inc.

LINK-LOCK provides pressure-tight closure on this rigidly specified equipment container

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- Compact design... lies flat against case even when unlocked.
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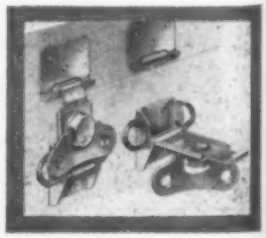
- Flexible engagement latch design...can be varied to suit different conditions.



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OCTOBER 6, 1958
VOL. 4, NO. 14

missiles and rockets
MAGAZINE OF WORLD ASTRONAUTICS

First "Instruction Missiles" Ready To Fire

Vandenberg Sets Date For Blast-Off Of *Thor, Atlas, Titan*

VANDENBERG AFB, CALIF.—The historic first firing of a ballistic missile —an intermediate range *Thor*—from this first U.S. ballistic missile training center will take place late in November or early December.

Technicians from Douglas, builders of the *Thor*, will install the missile. Air Force technicians-turned-instructors will fire it under the eyes of ballistic trainees from the U.S. and several other countries.

The first ICMB *Atlas* will be fired from Vandenberg next spring, probably under the same conditions, with Convair installing.

The first *Titan* is expected to be fired from Vandenberg in about one and a half years, probably—March or April of 1960—although this is a tenuous date at the present.

These will be the first major ballistic firings, except over the Cape Canaveral range, and the first for instruction purposes as opposed to testing purposes. The firings coincide roughly with the dates the weapons are expected to become operational—the *Thor* in England and the *Atlas* and *Titan* from U.S. bases.

• **Pacific range site**—Firings will be over the Pacific Missile Range operated by the Navy. This range encompasses a strip 500 miles long paralleling the California Coast and extending 250 miles into the Pacific. Beyond that, test corridors extend sufficient thousands of miles to sea to handle firings of both IRBMs (1,500 miles) and ICBMs (5,-500 miles).

Tracking stations are located along the coast of California and in Hawaii, with others to be added. These will be augmented at times of firings by Navy instrumentation ships, which will also record data telemetered from the missiles. Other vessels will patrol areas temporarily closed to shipping.

Maj. Gen. David Wade, first U.S. ballistic missile commander and boss of Vandenberg, has already accepted two *Thor* firing pads from the contractors. Acceptance of three *Atlas* pads is expected shortly. Two *Atlas* gantries are already up.

Originally Camp Cooke from World War I days, and then Cooke AFB when the Air Force took over the 64,-000-acre training center, the name was officially changed on Oct. 4 to Vandenberg Air Force Base in honor of the late AF chief of staff, Gen. Hoyt S. Vandenberg.

FIRST MISSILEMEN undergoing training at Vandenberg AFB (Cooke AFB) practice transporting an *Atlas* ICBM. The missile is hauled on a specially designed trailer from the missile assembly building (background) to the launch pad located approximately 7 miles distant. In addition to the driver, a missileman standing near the nose cone directs the operation by intercom. The man in the compartment under the engines, at the rear of the carriage, steers the trailer.

Titan and *Atlas* Are Both Safe

WASHINGTON—The chances that the Air Force will drop Martin's *Titan* ICBM are so small as to be almost non-existent.

The *Titan* is a war machine designed to travel 5,500 nautical miles and knock out a hardened target within a reasonable CEP. Peacefully, it is designed to boost heavy payloads into space.

In the present state of the missile art, the *Titan* is a fairly sophisticated vehicle. Its two-stage design gives it a much greater potential than earlier one-and-one-half stage weapons, in that the second stage can be used with newer and more power fuels as they are developed.

The *Titan*'s running mate, the Convair *Atlas*, also has a very secure place in the Air Force arsenal. Despite its most recent failure to fly the full designed range, the *Atlas* previously had three successful firings in a row. Eventually, of course, the *Atlas* will be phased out and replaced, quite probably by the *Titan*. But it is far enough ahead of the *Titan* that there is no thought in the Air Force, at the moment, of reducing its heavy procurement schedule.

Present plan is soft bases for the *Atlas*, hardened sites for *Titans*. Neither can be replaced by the smaller ICBM *Minuteman*, programmed for about 1962. The *Minuteman* is smaller and lighter, but carries a much smaller warhead.

Rumors of the *Titan*'s cancellation have come from two sources. The first is Defense Department Missile czar William M. Holaday. who has long been sniping at that particular program. Mr. Holaday's reasons are his own.

The second is a small group within the Air Force itself, who have advocated doing away with the *Titan* program and purchasing more B-52s. Even they, of late, have concurred with the general sentiment in the Air Force that this would be a giant step backward.

Nearly half a billion dollars have been spent to date on the *Titan* development program, and its sub and sub-sub contracts are scattered among 4,000 suppliers in 38 states. Static tests on the missile have been underway for months. One missile is already in the test stands at Cape Canaveral, but it is for checking out ground equipment only. The Air Force is expected to accept the first production test vehicle any day.

AFA Urges Single Armed Force

Texas Meeting Endorses Call For One Military Dept.; More Money For R&D; Increase In Armed Forces

DALLAS—Most important announcement made during the AFA convention here—attended by some 4,000 people—was the unanimously passed AFA Statement of Policy emphasizing that "we desperately need consolidation of our three military departments into *one* for efficiency, economy, coordination and the ability to respond instantly, with a maximum effort, in time of national emergency."

The statement outlines AFA's immediate concern with two of the fronts on which the Free World is fighting a war for survival; the first is the technical front, the second involves the capability of our present military forces.

"Under the current programming," the statement continues, "the Free World is losing ground on both fronts. Soviet strength and striking power continue to grow at a more rapid pace than our own. Our margin of security continues to dwindle. The Soviet lead in the satellite race should make this fact clear.

"Our peril would be clearer to the American people if our leaders make candid acknowledgement of their estimates of current and future Soviet forces to be posed against us—forces which daily grow more dangerous to our survival.

"In the face of this danger, we must better integrate our efforts upon both fronts. We must concentrate on weapons systems best designed to cope with the threat and ruthlessly eliminate the others. Service tradition and rivalries are inefficient and expensive luxuries that do not add to our national defense."

The statement also calls for increased expenditures for research and development of future forces appropriate to the changing threat, as well as an increase in today's forces to match the current threat, in order that our national defense effort can be expanded without endangering the economy.

The strong conclusion of the AFA Policy Statement reads: "We believe the people of the United States should be frankly informed of the grave danger in which they live. Any policy or program, no matter how costly, which leaves a margin or doubt that it is sufficient to meet the growing threat. involves an unacceptable risk to our nation's security. We believe the American people are currently being asked to take this risk without their full knowledge and understanding."

• Other Convention Highlights—

• USAF Ballistic Missile Division commander, Maj. Gen. Bernard A. Schriever, was named "Aviation's Man of the Year," and was awarded the AFA's General H. H. Arnold trophy.

• Gen. Thomas D. White, chief of staff, U.S. Air Force, said in a statement before the Space Age luncheon: "I want to point out that Air Force efforts, experience and capabilities in research on space operations are being oriented entirely toward development of military capabilities, which will assure that we can extend our air superiority into space. We recognize that the Air Force mission in space is solely a military mission—one which requires us to develop and produce military vehicles. However, Air Force experience and capabilities will always stand ready to assist in other fields if they are needed."

• Dr. Hugh L. Dryden, deputy administrator of NASA, said: "In my personal opinion, it is factually incorrect to state that the only proper justification for supporting work in space is military. Plainly, it is a perversion of the facts to suggest that all non-military space activity should be considered mere 'fun in space'."

• The Airpower Panorama demonstrated that we are in a definite period of transition from aircraft to space craft.

• General Electric's working model of its pulsed plasma accelerator, shown at the Panorama, produced a thrust of three-tenths of an ounce, sufficient to change the direction of a vehicle in the near-perfect vacuum of outer space.

Army and Navy Groups Oppose AFA Views

Unanimous adoption by the Air Force Association of a policy in favor of a single service brought immediate response from the AFA's opposite numbers.

In a special statement to m/r, John J. Bergen, president of the Navy League, said:

"The Air Force Association statement of policy advocating a single force does not appear to have much practical meaning in view of the legislation passed by Congress this past summer.

"You cannot increase breadth of knowledge of individuals by issuing an edict. Experts in land, sea and air warfare are still needed. The machinery already exists at the Department of Defense level to eliminate unnecessary duplication.

"I believe it would be a great disservice to the cause of defense efficiency to press for such a dangerous and drastic proposal."

Speaking for the Association of the U.S. Army, Lt. Gen. Walter L. Weible, USA (Ret.), executive vice president, called attention to the policy adopted at last year's meeting, urging membership to "actively support maintenance of the separate identity of the services, including the assurance that all shall have parity of expression of their views in the highest executive and legislative councils."

The AUSA policy was adopted, the resolution said, in view of no evidence that a single service or Chief of Staff would promote efficiency and economy, and that a single service would stifle initiative and lower competition spirit.

AFA To Sponsor World Congress of Flight

DALLAS—Peter J. Schenk, President of the Air Force Association announced here that the association will sponsor the first World Congress of Flight to be held at Las Vegas Nevada, between April 12 and 19, 1959.

The Congress, which is expected to be the biggest of its kind, will cover the Jet Age, the Missile Age, and the Space Age. Although an estimate on number of participants was not available, it was said that the attendance will be international.

AFA's Fourth Annual Jet Age Conference (originally scheduled for late February in Washington) will be featured along with a Missile Management Conference and a Space Age Conference. The two latter will be sponsored by AFA's Space Education Foundation.

An international exposition—including an exhibition of aero-space equipment—similar to the Farnborough show is planned in conjunction with the congress.

X-15 Scheduled to Make Debut Oct. 15

by Norman L. Baker

WASHINGTON—The completed package of the X-15, the most advanced concept in the aeronautical and astronautical vehicle design state of the art, will roll through the doors of North American's Los Angeles Division sometime next week.

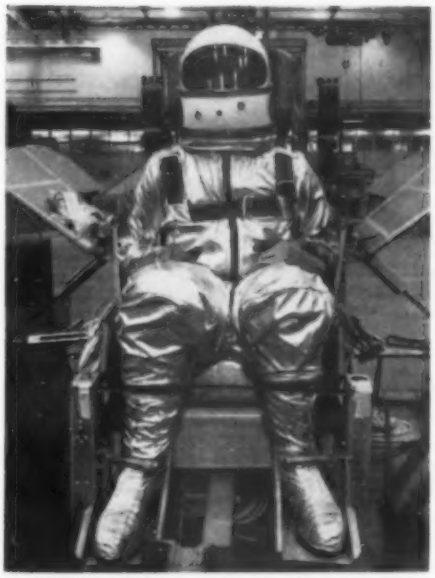
This, the first of three under construction and the latest generation of a series of advanced research craft, is destined to probably play the most history-making role of all the X series of aircraft. The X-15 must bridge the gap between two eras of technology—the transition from aerodynamics to the virtually unexplored field of astrodynamics.

The role of the X-15 is similar in many respects to the famed X-1 sonic-barrier research vehicle. Both were designed for an assignment that would involve the searching of the 'gray' limits of man's knowledge of flight. Both of the vehicle's designs were based on unproven theories, theories that can be proven only by actual flight test in the environments for which they were designed.

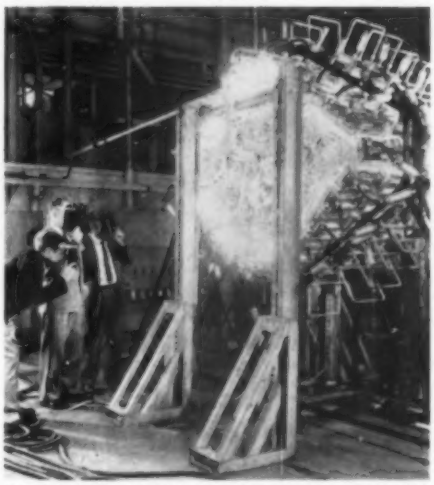
• **Flight weeks away**—The space research phase of the X-15 is still many weeks away. The vehicle is expected to roll from NAA's plant minus its Reaction rocket power plant. At last report the engine was still in its final test program at the Reaction plant.

NAA test pilot Scott Crossfield will take the craft through an extensive 'wringing out' program before it is delivered to the Air Force early next spring. This first phase of a three divisional operation will carry the vehicle through an involved 'air worthiness' check-out starting with unpowered glide flights, through high altitude powered flights with ballistic attitude control system. Crossfield will make no attempts to take the X-15 through its maximum of velocity and altitude. After North American is satisfied with its 'de-bugging' and evaluation program, the vehicle will be turned over to the Air Force research team at Edwards Air Force Base.

At Edwards, the X-15 will be tested to the limits of its design capabilities by a team of fliers headed by Capt. Robert (Bob) White. In a series of small steps this team will gradually move farther out into the space environment and deeper into the hypersonic regime. The X-15 will quickly enter the transition area between the atmosphere and true space conditions



FLIGHT SUIT protects pilot in X-15 flights.



COCKPIT AREA tested for heat, cold.

investigating control, orientation, and stability in this critical area. As the vehicle goes through a ballistic arc in its flight pattern, the pilot will be subjected to acceleration, weightlessness, and deceleration where his ability to perform the functions of controlling the vehicle will mean the difference between success and failure.

• **Parallel program**—NACA will join the Air Force at Edwards in a parallel research program. While the Air Force tests will be of a current vehicle design evaluation nature, NACA will conduct detail flight research for later generation space research vehicles. Heading the NASA flight team will be Joseph Walker with a backup by Neil Armstrong.

During all research flights, the NASA will have primary responsibility. It also will operate the flight test range between Wendover AFB (the position of launch of the X-15 from the B-52) and Edwards AFB, and will be responsible for data reduction and reporting.

Unlike the preceeding rocket aircraft research programs, where only one vehicle was available for testing, all three X-15s will be going through their paces throughout the program. In addition to accelerating the program, this procedure will preclude any holdup in case of destruction of one of the vehicles.

• **Manned missile**—The X-15 is for all practical purposes a manned ballistic-glide missile. Its 50-ft. cylindrical fuselage resembles current finned ballistic missiles. The cockpit payload is located well forward in the nose, followed by the propellant tanks and the 60,000-lb. thrust rocket engine system. Controls, plumbing and wiring are routed along the fuselage through two large projecting tunnels on either side of the ship.

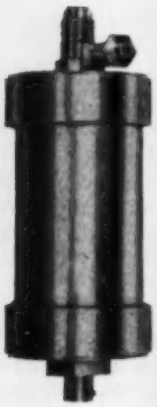
Midway on the fuselage is mounted the thin supersonic wings with large radius leading edges (for dissipation of heat) and blunt trailing edges. The vertical and horizontal tail surfaces are extremely blunt on the trailing edges. Only the top vertical fin moves for directional control while the horizontal surfaces are all-movable. Landing gear (skids in the rear and nose wheel) is identical to the late X-2.

• **Clothed in steel**—The X-15 is an all-steel craft, clothed in nickel alloy steel, titanium and stainless steel to combat high aerodynamic heating. The outer skin, designed to absorb the initial heat buildup, is nickel alloy with stainless steel and titanium on the inside. The use of aluminum for internal use is held to a minimum. The side panels are chemically milled after forming for additional weight saving.

Manufacturing techniques are similar to those used in the construction of missiles, marking a transition in the fabrication of manned systems. About 65% of the X-15 will be welded structure, compared with 100% fastened structures for current aircraft systems. Automatic and resistance welding has been used in joining the structural frame.

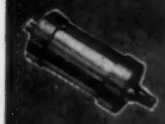
The heat-resisting structure of the X-15 is reported, by North American,

SYSTEMS RELIABILITY



with . . .

GAS GENERATORS



These extremely versatile units are being used in aircraft and missile systems to operate hydraulic pumps, electric generaters, gyroscopes and turbo-blowers; to inflate flotation bags; to pressurize hydraulic accumulators and pneumatic systems and a wide variety of similar applications.

Units are very light in weight, compact in size and can be produced to meet individual customer specification. Gas produced is of controlled pressure, mass-flow and temperature, independent of external environment, acceleration or vibration.

Mc/S/A is also producing igniters, pressure cartridges, explosive bolts, initiators and hi-pressure electrical connectors for ordnance rockets, guided missiles, aircraft and commercial uses.

Write in for detail technical data.

Explosive Ordnance by

McCormick Selph Associates

Hollister Airport — Hollister, California

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. . . X-15 Rollout Scheduled

to be the key to the vehicle's design. Exhaustive temperature tests consumed a major portion of the development program. Although the engineers were more concerned with external aerodynamic heating, all the internal structure was subjected to heat tests under external pressure and bending loads. Little damage to the structure of the X-15 is expected as a result of its characteristic of constant and rapid flight through critical temperature areas. During re-entry certain areas of the ship's skin may reach a temperature of 600 degrees C, leading edges and control surfaces will top 1000 degrees C.

• **Program in sixth year**—The X-15 project was initiated in 1952 when NACA directed its laboratories to begin studies for the problems likely to be encountered in flight beyond the atmosphere and the methods of exploring them. By the spring of 1954 the characteristics of the craft necessary for this investigation had been determined. Independent proposals of the Air Force Scientific Board, the Navy Bureau of Aeronautics and NACA were submitted as a joint proposal to the Asst. Secretary of the Air Force for Research and Development with the resultant DOD approval in December 1954. Nineteen hundred fifty-five was a year of heavy design competition for the X-15 by several contractors having experience in the design of high altitude, high velocity airplanes. North American was given the go-ahead in December 1955 with a contract to build three X-15s with the Air Force providing the bulk of the funds (approximately $100-million) for the design, construction, and support of the research craft, in addition to supplying the mother B-52.

AF INDUSTRY AND RESEARCH LEADERS discuss space logistics. (Left to right) C. N. Zimmerman, NACA; Brig. Gen. L. B. Kelley; S. H. Dole, Rand Corp.; Brig. Gen. H. A. Boushey.

Reliability Stressed As Key to Space Logistics

MAXWELL AFB, Ala.—Reliability is the biggest single factor in solving the logistics problems of space travel and exploration. This was one of the conclusions reached by representatives of industry, several government agencies and key Air Force personnel at the 10th AF Long Range Logistics Discussion Group meeting at Maxwell AFB last week. This was the first such conference devoted to the problems of supplying space stations and vehicles.

"We are meeting here to get a feel for the future," said Brig. Gen. L. B. Kelley, Director of Logistics Plans, USAF Headquarters, "so that we can better anticipate the problems."

Gen. Kelley emphasized that the meeting was not for the purpose of discussing any AF program or any national program, but only to explore generally the logistics implications of space, and to determine the lines along which the Air Force should be thinking.

Some 65 persons from AF, industry and government agencies attended the closed sessions. A series of lectures was given on practically every aspect of space and followed by a brief discussion period. These lectures included: The Space Environment—S. H. Dole of the Rand Corp.; General Space Activities—C. H. Zimmerman, NACA; Keeping the Spaceman Alive—Col. C. H. Roadman, USAF; Astrodynamics of Space Vehicles—Dr. W. R. Dornberger, Bell Aircraft; Reliability and Development Testing—Maj. Gen. L. I. Davis, USAF; Space Vehicle Design—Dr. Krafft Ehricke, Convair; Propulsion for Space Vehicles—Lt. Col. P. G. Atkinson, USAF; The Development of Space Law—Mr. J. A. Johnson, Chief Counsel of the AF; and Military Use of Space Vehicles—Brig. Gen. H. A. Boushey, USAF.

An invitation to senior scientists and engineers

A $14,000,000 R & D Center, housing 9 new laboratories, was revealed as core of Republic's $35,000,000 Research and Development Program at recent announcement by Mundy I. Peale, President, and Alexander Kartveli, Vice-President for Research and Development.

.... To join Republic Aviation's new $35 million Research and Development Program for spacecraft, missiles and advanced aircraft

In announcing Republic's $35 million research and development program, designed to arrive at major breakthroughs in the aviation industry's transition to astronautics, Mundy I. Peale, President, set the following objectives:

> "... ACCELERATION OF PROJECTS ALREADY UNDER WAY AT REPUBLIC ON LUNAR PROGRAM FOR MANNED SPACE VEHICLES, AND MISSILES TO DESTROY ORBITING WEAPONS, AND INITIATION OF INVESTIGATIONS LEADING TO NEW CONCEPTS FOR INTERPLANETARY TRAVEL."
>
> "... RADICAL NEW FAMILIES OF LONG-RANGE AIR-TO-AIR MISSILES AND AIR-TO-SURFACE BALLISTIC MISSILES FOR STRATEGIC AND TACTICAL AIRCRAFT."
>
> "... VERTICAL TAKE-OFF FIGHTER-BOMBERS, HIGH-MACH FIGHTER-BOMBERS, AND SUPERSONIC TRANSPORTS."

Alexander Kartveli, Vice-President for Research and Development, emphasized that Republic's program "will not duplicate in any way investigatory work currently in progress elsewhere, but will stress novel concepts and new approaches to basic problems of missiles and space technology."

The program includes construction of a $14 million R & D center to house 9 new laboratories, and anticipates doubling the present research staff.

Senior men interested in the new possibilities created by a simultaneous exploration of all aspects of Flight Technology are invited to study the functions of the new laboratories for more detailed information:

SPACE ENVIRONMENTAL DEVELOPMENT LABORATORY
To simulate space flight conditions and test missile, satellite and spacecraft systems and components; investigate human engineering problems.

RE-ENTRY SIMULATION & AERODYNAMIC LABORATORY
To study hypersonic shock dynamics, real gas effects, heat transfer phenomena and magnetohydrodynamics.

MATERIALS DEVELOPMENT LABORATORY
Study effects of high velocity, temperature, and space environment on materials for spacecraft, missiles and advanced weapons.

GUIDANCE & CONTROL SYSTEM DEVELOPMENT LABORATORY
To develop and test guidance and control systems for spacecraft, missiles and aircraft.

ELECTRONICS DEVELOPMENT LABORATORY
Study and explore all problems connected with highly specialized, complex electronic systems required for advanced forms of spacecraft, missiles and aircraft.

ADVANCED FLUID SYSTEMS DEVELOPMENT LABORATORY
To develop and test fluid power systems for spacecraft and missiles capable of operation under extremely high temperature, high pressure conditions.

MANUFACTURING RESEARCH & DEVELOPMENT LABORATORIES
To develop advanced manufacturing processes and techniques for materials used in missiles and spacecraft. Laboratories for each of the following areas : *Non-Metallics, Metallics, Welding*.

Qualified men are invited to write directly to:
A. Kartveli, Vice President, Research and Development

REPUBLIC AVIATION
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MODERN TESTING METHODS Assure Product Reliability and Quality for Jefferson Electronic

DIT-MCO Circuit Analyzers Automatically Detect Finite Flaws in Highly Complex, Multiple Interconnected Circuitry

A simple, efficient system for planning, performing, controlling and recording the complete test cycle of any electronic or electrical circuitry has been developed by DIT-MCO, Inc., Kansas City, Missouri. This revolutionary concept can virtually eliminate electrical circuitry errors, both in assembly line and custom manufacturing operations. In action at the Jefferson Electronic Products Corporation, of Santa Barbara, California, it provides the exacting quality control and reliability which have helped to make the company's products famous. In addition to quality control and universal application, the system improves interdepartmental communications, facilitates coordination and provides up-to-the-minute test information at any stage of planning, production or maintenance.

This new testing system is built around the DIT-MCO Circuit Analyzer, a highly accurate, automatic circuit tester which makes rapid, sequential tests of any complex, multiple interconnected circuitry. The basic model tests up to 200 circuits in twenty seconds, and test capacity can be enlarged to any required degree by adding multiplier sections. It detects potentially dangerous, finite wiring flaws by simultaneously testing one wire against all others commoned together . . . without special connections. All external resistive devices are automatically energized and functionally tested, and circuits connected together at common terminal points are thoroughly checked. The Analyzer never requires internal modification and easily adapts to any test by use of adapter cables. The exclusive DIT-MCO Matrix Chart pinpoints error location, circuit number, type and amount of fault, enabling technicians to make corrections without reference to manuals or diagrams. Standard, telephone-type components give years of trouble-free service with minimum maintenance. Nontechnical personnel easily master operation with less than one-half hour's instruction.

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"Modern Testing Methods" tells how DIT-MCO's comprehensive electrical or electronic testing system can save time and increase the reliability of your product. It offers a practical, tested plan for standardizing and improving your testing methods. It's yours for the asking, without obligation. Send your name, title, and company address to:

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. . . Space logistics

Following the lectures, a series of five seminars, with a general officer heading each, discussed personnel facilities, maintenance, supply and transportation implications of space planning.

"From industry," Gen. Kelley, the sponsor, said, "we have gotten a feel for the type of vehicles we will need and from the medical people we have learned some of the human factors and problems to be solved."

Lack of foresight, the General continued, frequently causes us to do many things we would not do and spend money we would not otherwise have to spend.

"The biggest asset we can have," Gen. Kelley said, "is reliable hardware which will enable us to solve the problems of trajectory, velocity, communications and guidance—a degree of reliability far beyond that which we have required thus far."

The same thought was voiced by Dr. W. R. Dornberger of Bell who said that current guidance and telemetry would not solve the problem.

"The rendezvous is the main thing," Dr. Dornberger said, "it will be a very difficult task to get the supplying vehicle in the same plane, at exactly the same speed and at the same time so that supplies and personnel can be transferred from one to the other."

Dr. Dornberger said he did not believe the Russians were putting very much effort into lunar probes, but were concentrating on getting the manned satellite.

"This would be a great achievement and have great psychological value as it would really open the door to space travel," Dornberger said, adding that he did not think this country is neglecting the man in space projects in favor of lunar probes but rather that both projects are being given emphasis.

Brig. Gen. Boushey, Director of Advanced Technology and AF Deputy Chief of Staff for Development said many might have the wrong idea about space logistics.

"We don't now envision thousands of space ships all over the place. Rather, our goal at the present is economy. That is, how to get a pay load into orbit at a minimum cost," he said.

In discussing the human factors involved, Col. C. H. Roadman, Chief of AF Human Factors Division said that while the exact dimensions of the radiation belt indicated by satellites, he did not see it as a great barrier and predicted that it might be that eventually a space pilot would get a radiation forecast in the same way today's pilots get a forecast.

Circle No. 22 on Subscriber Service Card.

Navy Confident of Meeting IRBM Schedule

With the first flight test involving operational engine components of the *Polaris* Fleet Ballistic Missile (which was put through test firing last week at Cape Canaveral), the Navy is confident that tight test schedules in the IRBM's development will be met despite a guidance failure.

The test was essentially for the Aerojet-General first and the Thiokol second stages. Flight tests using a motion simulator, already completed at the Air Force Missile Test Center, are programmed for the near future.

It has been learned that some 21 out of 22 "dummy" test vehicles thus far tested have been successful, and a number of static tests also have reportedly achieved a "high degree" of success.

British Get Swedish Order for New Missile

The Royal Swedish Airboard has placed an order with Bristol Aircraft, Ltd. for Great Britain's surface-to-air missile, *Bloodhound*. The number of missiles was not disclosed.

The 22-foot missile has been under development since 1949. Two *Thor* ramjet engines, mounted above and below the fuselage, supply sustaining power. Solid propellants boost the missile to operating speed at the rate of 1,500 fps. It uses a combination of beam and homing systems for guidance.

According to President David Proudlove of Bristol Aeroplane Company U.S.A. Inc., it is the first export order for a British-developed defense missile.

TAC Shows *White Lance*, New Air-to-Surface Missile

The Air Force's Tactical Air Command has unveiled its new White Lance air-to-surface missile.

A modified version of Navy's Bullpup, White Lance incorporates changes in the propulsion system, guidance system and payload. It has the same general shape as Bullpup, and will be used by TAC in attacking ground targets.

Bomarc Replaces CF-105

Boeing's IM-99 Bomarc will become Canada's major air defense weapon, confirming a foremast made by m/r (July 28, p. 49).

Canada will cancel a planned $2-billion production program for the supersonic CF-105 *Avro Arrow*. The aircraft's flight and fire-control system (Astra), and the *Sparrow* missile, also got the economic axe.

REDUCE
BREAKDOWN FAILURES

NEW
WELWYN
MOLDED
DEPOSITED CARBON RESISTORS

The use of a thermo-plastic insulation material has resulted in an economically priced molded carbon resistor of markedly improved endurance and long term stability.

Type N resistors subjected to several one-hour cycles of immersion in boiling water — while DC polarized — have revealed only negligible changes in resistance. Continuous operations at 150°C caused no damage to the component.

The new Type N resistor, a deposited carbon film fired onto a porcelain rod, is first tropicalized with multiple coatings of panclimatic lacquers to give it long term moisture resistance, and is then molded in a thermo-plastic material.

This molded insulation has an effective resistance in the order of 10^{13} ohms. Its inherent thermal conductivity is approximately ten times that of air, resulting in substantially improved load life under conditions involving excessive or high wattage dissipation. Similarly, Type N resistors may be soldered as close to the insulation as desired without fear of melting or deforming the cover.

One added advantage of the Type N is that the original markings on the resistor body remain visible and legible through the transparent molded material.

Welwyn Type N carbon resistors meet the requirements specified by MIL-R-10509B, and are available in all values, ranging from 10 ohms through 1 megohm. For complete data and specifications write to Welwyn International, Inc., 3355 Edgecliff Terrace, Cleveland 11, Ohio.

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Job for Electronics: Weighing Big Missiles

Center-of-gravity determination—one key to missile reliability—makes use of special techniques to insure distribution of weight.

Among many critical and complex techniques used to increase and assure the reliability of ballistic missiles is a technique utilized by Chrysler Missile Division engineers for determining the exact center of gravity of each missile.

The center of gravity is a key element in missile design, and greatly affects the flight path or trajectory of a missile during flight.

Basically, the center of gravity of a ballistic missile is determined by weighing each component and electronically weighing assemblies and sections of the missile, as well as the entire completed missile.

The center of gravity is extremely critical in relation to the top or body section. At the point of trajectory where burn-out occurs, the body is separated from the thrust section. This separation must occur with minimum disturbance to permit the body to continue in the predetermined trajectory.

The Structural Design Department at Chrysler Missile Division calculates the predicted weight and center of gravity for each missile. To insure proper balance, they receive information on the actual weight of each component as it is installed in the missile, and check actual weight against predetermined weight calculations. It is essential, in confirming the exact center of gravity, that the weight of each component or unit placed in the missile stays within established weight tolerances.

The problem of accurately weighing large and heavy missile sections and entire missiles has been solved with a servo null-balance instrumentation system designed and built by Performance Measurements Co., Detroit, Michigan.

• **Weighing the missile**—When all components are installed in the missile, the resultant center of gravity location is determined by the electronic weighing system with a digital readout. The missile is suspended by two cables. A strain gage load cell is attached in series with each cable between the missile and an overhead crane. Each cell has a 10,000 pound capacity.

During the weighing operation, the missile fule tanks are filled to simulate actual weight distribution during a flight. Before the cables are attached to the missile, the load cell system is balanced to read zero; this excludes the weight of the cable, yoke and shackles from the final weight reading. Then the cables are attached to lifting stations or suspension points which are designed into the missile. The missile can then be lifted into the air by the crane.

Suspension points on the missile are located during the manufacturing operation to a tolerance of 0.030 inch for each point. Exact placement of the lifting stations is of course essential in determining weight distribution.

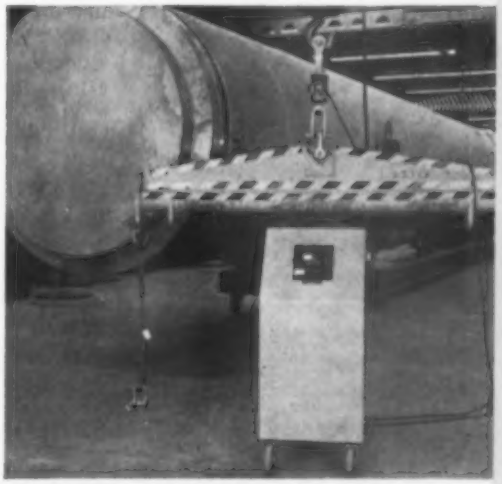
• **Weighing instrumentation**—As shown in the block diagram of the weighing system, the digital indicator consists of a measuring circuit, an electronic amplifier, precision slide wire, and a servo balancing motor.

An excitation voltage is placed across each of the load cells, the strain gage bridges within them become unbalanced. This unbalance is translated electronically into an indicator reading calibrated directly in pounds.

The heart of the weighing system is the servo null-balance indicator with digital readout, developed by Performance Measurements Co. The performance measurement team responsible for the project was headed by Donald Courtney. The servo-null-balance portion of the instrumentation incorporates a precision slidewire (infinite resolution potentiometer) in a bridge circuit. This potentiometer has a linearity of 0.025%. The entire system allows 0.1% of full scale accuracy in weight measurements.

The internal slidewire is the major component of the internal bridge. The amplifier compares the unbalance of the load cell bridge with the voltage across the internal bridge. Any difference in these two signals is chopped and amplified.

This signal then energizes the servo balancing motor, causing it to turn the potentiometer in the direction for a balanced null. Number wheels are geared directly to the slidewire shaft,



READY for weighing operation, yoke and null-balanced servo are set up.

HELD IN YOKE, missile registers full weight on servo from two points.

AIR TRANSPORT of missile is another reason for determining center of gravity.

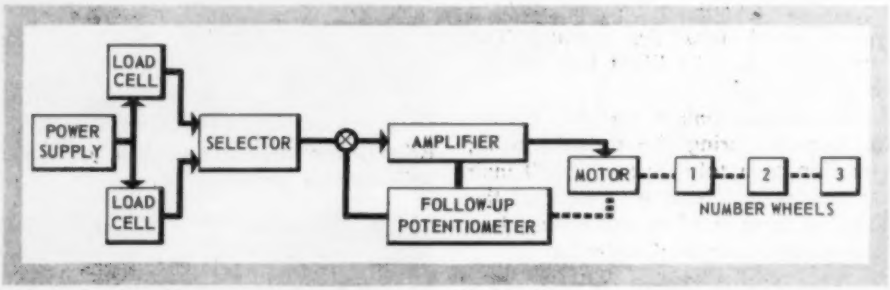
so that the digital readout has a constant relationship to the slidewire position.

Both the load cell and internal bridge circuit are supplied from the same voltage source, so that line variations do not affect accuracy of readings. In fact, this circuit arrangement allows up to ± 50% variation in bridge supply voltage with no change in zero or span.

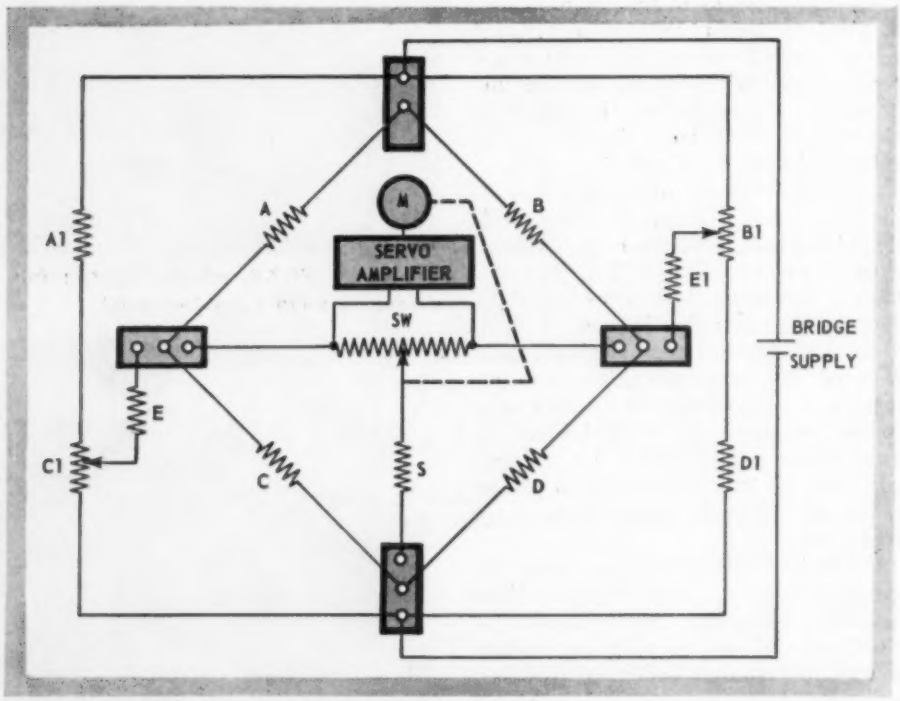
To actually determine the center of gravity, calculations are made on the basis of both the total recorded weight of the entire missile and the individual weight readings taken from each load cell. A channel selector on the instrument allows the engineer to take readings from each load cell individually; only one digital indicator is needed.

Electronic weight determination of components or finished missiles provides highly accurate weight data for aeroballistic purposes. This is one of the techniques used to prove theoretical calculations and reduce the margin for error complex processes involves in the building of successful missiles.

The increasing need to transport missiles by air is another pressing reason for accurate weighing, since stability of the load as well as relationship of load to lifting capacity of the carrier, is of course a matter of major concern.



OUTPUT of bridge-type strain gage load cell pickup feeds to input of digital indicator, in this block diagram. Indicator is servo null balance type, equipped with an electronic amplifier, multiple-turn tapped precision slide wire and servo balancing motor. Motor drives number wheels for digital readout.



IN OPERATION, a load or unbalanced signal in the external bridge causes a current through the slidewire (SW), which is translated as an error voltage, then the motor rebalances the error, the amount of unbalance being read as load. A,B,C,D are load cells in external bridge; A_1,B_1,C_1,D_1 are located inside the indicator. E, E_1 are resistors which isolate the balanced zero control (C_1 and B_1) from the external bridge. Resistor S determines amount of unbalance, or span, permitted.

13 New Members Admitted to EIA

Thirteen additional firms have been accepted for membership in the Electronic Industries Association by action of the Board of Directors during the Association's three-day fall conference in San Francisco, Sept. 16-18.

The action of the Board was based on recommendations of the various EIA divisions involved. The firms are:

Aeronutronic Systems, Inc., 1234 Airway, Glendale 1, Calif.

Amco Engineering Co., 7333 W. Ainslie St., Chicago 32, Ill.

Columbus Electronics Corp., Semiconductor Div., 1010 Saw Mill River Rd., Yonkers, N. Y.

Continental Illinois National Bank & Trust Co. of Chicago, 231 South LaSalle St., Chicago, Ill. (Associate Member).

The Martin Co., Baltimore 3, Md.

Master Mobile Mounts, Inc., 1306 Bond St., Los Angeles 15, Calif.

Resitron Laboratories, Inc., 2908 Nebraska Ave., Santa Monica, Calif.

The Siegler Corp., 610 S. Harvard Blvd., Los Angeles, Calif.

SNC Manufacturing Co., Inc., P. O. Box 277, Oshkosh, Wisc.

Syncro Corp., Electronics Div., Meusse Argonne Ave., Hicksville, Ohio.

U. S. Semiconductor Products, Inc., 3536 West Osborn Rd., Phoenix, Ariz.

United Transformer Corp., 150 Varick St., New York 13, N. Y.

Wyco Metal Products, 6918 Beck Ave., North Hollywood, Calif.

Litton Industries Purchased by Westrex

Announcement was made recently of the purchase of Westrex Corporation by Litton Industries, Inc. Purchase price of Westrex, formerly a wholly-owned subsidiary of Western Electric Company, was not disclosed.

Westrex foreign offices are commencing distribution of Litton communication equipment, radar antennas, instrument landing systems, and medical x-ray units.

Upon the completion of the transfer of ownership, Westrex now handles tropospheric and ionospheric scatter relay equipment for over-the-horizon communication and a new line of communication and power wire and cable. Westrex, a Delaware corporation, operates 19 foreign sales, service, and distributing subsidiaries. The company employs more than 1200 persons, 1000 of which are overseas. An assembly plant is maintained in England. Gross income for 1957 was more than $13 million.

Contractors Selected For $60 Million Navy Project

Navy has identified the successful applicant for the prime contract to construct the giant $60 million Naval Radio Research Station at Sugar Grove, West Virginia. Selected as a joint venture for the prime contract from a list of about 125 firms, were three contractors representing three states—Virginia, Pennsylvania and Nebraska. The three firms of the joint venture are Tidewater Construction Corporation, Norfolk; Peter Kiewit Sons, Omaha; and Patterson-Emerson-Comstock Incorporated, Pittsburgh.

The project involves the fabrication and erection of a giant steerable radio telescope to be used in studies of outer space, advanced scientific research on characteristics of the earth's atmosphere, and geodetic and geomagnetic studies of the earth.

It is anticipated that major construction work will commence no later than October 15, 1958. Bids have already been solicited from subcontractors for preliminary ground work.

Final selection for the prime contract was made by a special contract selection board appointed by Rear Admiral E. J. Peltier, Chief of the Navy's Bureau of Yards and Docks, from a list of 10 best qualified firms which were carefully screened from the larger list. The Bureau of Yards and Docks will administer the project for the Navy through the District Public Works Office, Fifth Naval District, Norfolk, Virginia.

Newest *Falcon* Shown, Has Greater Speed, Range

DALLAS—Existence of new supersonic air-to-air guided missile that is said to climb higher, fly faster and have a greater range than any of its predecessors, has been announced by the Air Force and Hughes Aircraft Company, developer and producer.

Fourth in the family of *Falcon* missiles produced by Hughes for the Air Force, the new GAR-3 (guided air rocket) is scheduled to go into operational service soon as principal firepower for advanced all-weather jet interceptors.

Roy E. Wendahl, vice-president and manager of Hughes' airborne systems group, described the newest *Falcon* as "a semi-active radar seeker type, incorporating advanced engineering and manufacturing techniques."

astrionics

by Raymond M. Nolan

Communications from space vehicles were given a boost recently with the announcement by the University of Michigan of its ruby maser—capable of outperforming both vacuum tubes and transistors. In the ruby maser system, the ruby is placed in a magnetic field and immersed in liquid helium. The magnetic field aligns the electrons of the ruby's atoms while the frigid helium reduces noise due to atomic motion. Electrical energy is supplied to the ruby's electrons so that an incoming radio signal can trigger its release and produce a large signal output. U-M researchers see eventual production units in packages no larger than a filing cabinet.

Major procurement and production contracts placed by the Defense Department in FY 1958 totalled $16 plus. Of this amount, electronics and communications totalled a little more than $1 billion. The figures do not include programs budgeted with research and development funds or production equipment obligations to support aircraft, missiles or electronics equipment.

DOFL (Diamond Ordnance Fuze Laboratory) recently celebrated its 5th anniversary with an open house. Among the exhibits was a first showing of the micro-miniaturization techniques developed by DOFL and felt by many to be the foremost in the country. Some future items will be digital modules about the size of a five cent piece and several times as thick. The electronics components will be embedded in ceramic and will be capable of being stacked in almost any configuration. Another DOFL item of interest is its short-pulse radar, developed in conjunction with a proximity fuzing device. Said to be as close to unjammable as you can get with radar.

The new missile *"White Lance"* to be employed by the Tactical Air Command is reported to be a *Bullpup* with improved guidance, a new propulsion system and a "different" warhead. No details are known about the propulsion system, but the improved guidance is probably the television guidance that Martin has been trying on versions of the *Bullpup*. TV guidance was tried during WW II but was not very successful because of vehicle preturbations which disturbed the picture. The system now being tested reported has solved this problem and gives a stable TV image so that the pilot, who controls the missile from the airplane, can achieve positive control even when *White Lance* is out of visual range. The different warhead can only mean a nuclear one since present versions of the *Bullpup* use high explosive. (See also p. 21).

A recent achievement of the National Bureau of Standards was the free precession determination of the proton gyromagnetic ratio. Importance of this will be felt by many research projects since it means that the proton can now be used as a very sensitive probe to determine magnetic intensity in terms of the precisely known gyromagnetic ratio. Specific applications will range from cyclotrons and mass spectrographs to servo mechanisms and electromagnets. The NBS work is part of a broad scale program which seeks to obtain more accurate values for constants such as the velocity of light, the acceleration of gravity, and the various atomic constants. Like other atomis nuclei, the proton, or hydrogen nucleus, behaves as a small magnet. When placed in a magnetic field, it tends to orient its axis along the direction of the field. But, because the proton is spinning itself, it acts somewhat like a gyroscope and precesses about the field direction. The ratio of the angular precession frequency to the magnetic field strength gives the gyromagnetic ratio.

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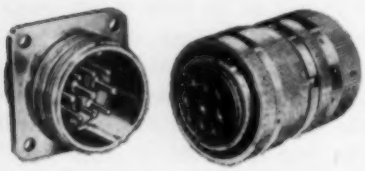

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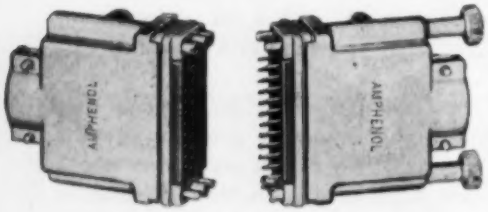

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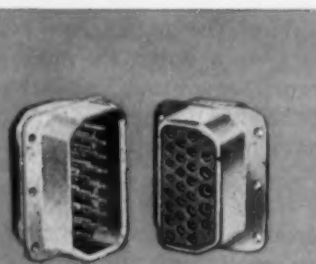

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. . . missile electronics

Scope Inc., New R&D Company Organized

Announcement was made recently of the formation of a new company, Scope Inc., by several former employees of Melpar Inc.

Scope was originally the Wilbespan Research Labs, but activities were then on a smaller scale. The new company intends to direct its work in the research and development field in the physical sciences. It is located in Fairfax, Virginia.

Co-founders of Scope Inc. are Richard E. Williams and Johnathan J. Broome, both formerly with Melpar. Mr. Williams was assistant to the VP for Research and Engineering, and Mr. Broome was assistant to the Executive VP.

Navy Scientists Hear Report On Missile Guidance Filters

Properties of infrared interference filters used in the guidance systems of missiles and rockets were recently reported by Kodak scientist Paul B. Mauer at a Naval Research sponsored meeting on infrared information in Boston.

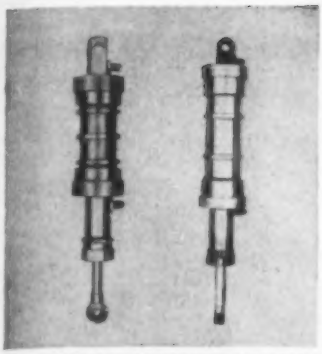
Mauer reported the characteristics of various filter types used to screen out unwanted wavelengths of infrared energy. This property makes the filters of great value in a missile guidance system because they can discriminate between the radiation coming from a target and energy coming from the sun or the target background.

Mauer's talk included comparisons of various filter materials and graphs of their transmission properties under differing conditions. He also showed ways in which filters can be out or combined to give desirable transmittance characteristics.

EIA Opens New Standards Laboratory

A standards laboratory to perform test measurements for tube and semiconductor manufacturers has been placed in operation by the Electronics Industries Association.

The long-established laboratory, located in Newark, N.J., formerly was operated at the same address for receiving and cathode ray tube manufacturers as a part of the RCA Industry Service Laboratory. EIA tube manufacturers have combined this with a similar operation of semi-conductor manufacturers which had been conducted at Syracuse University. Availability for use by the Armed Services is planned for the future.



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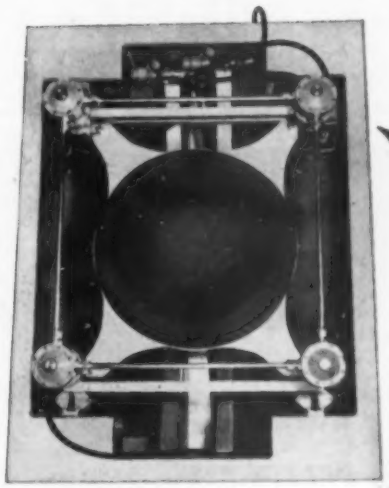

Vibration Isolation System

Vibration Isolator

Newest Kidde development: The Pneumatic Vibration Isolation System. Employing relatively inexpensive components, it maintains desired low natural frequency and reduces the relative displacement at various load conditions.

The system shown above is one of several Kidde pneumatic vibration isolation system programs for protecting delicate missile control systems from undesirable vibratory disturbances and great transients in "g" loading which would affect accuracy of control. The component in the inset photo incorporates the system's mechanical and air snubbers, air spring, servo valve and passive isolator.

Research on projects like this new vibration isolation system goes on constantly in Kidde's vast creative pneumatics engineering department. For more information on any Kidde components, or help in solving specific pneumatics problems, write or call Kidde today.

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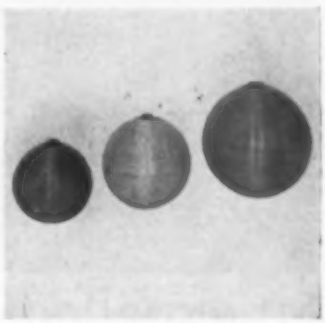

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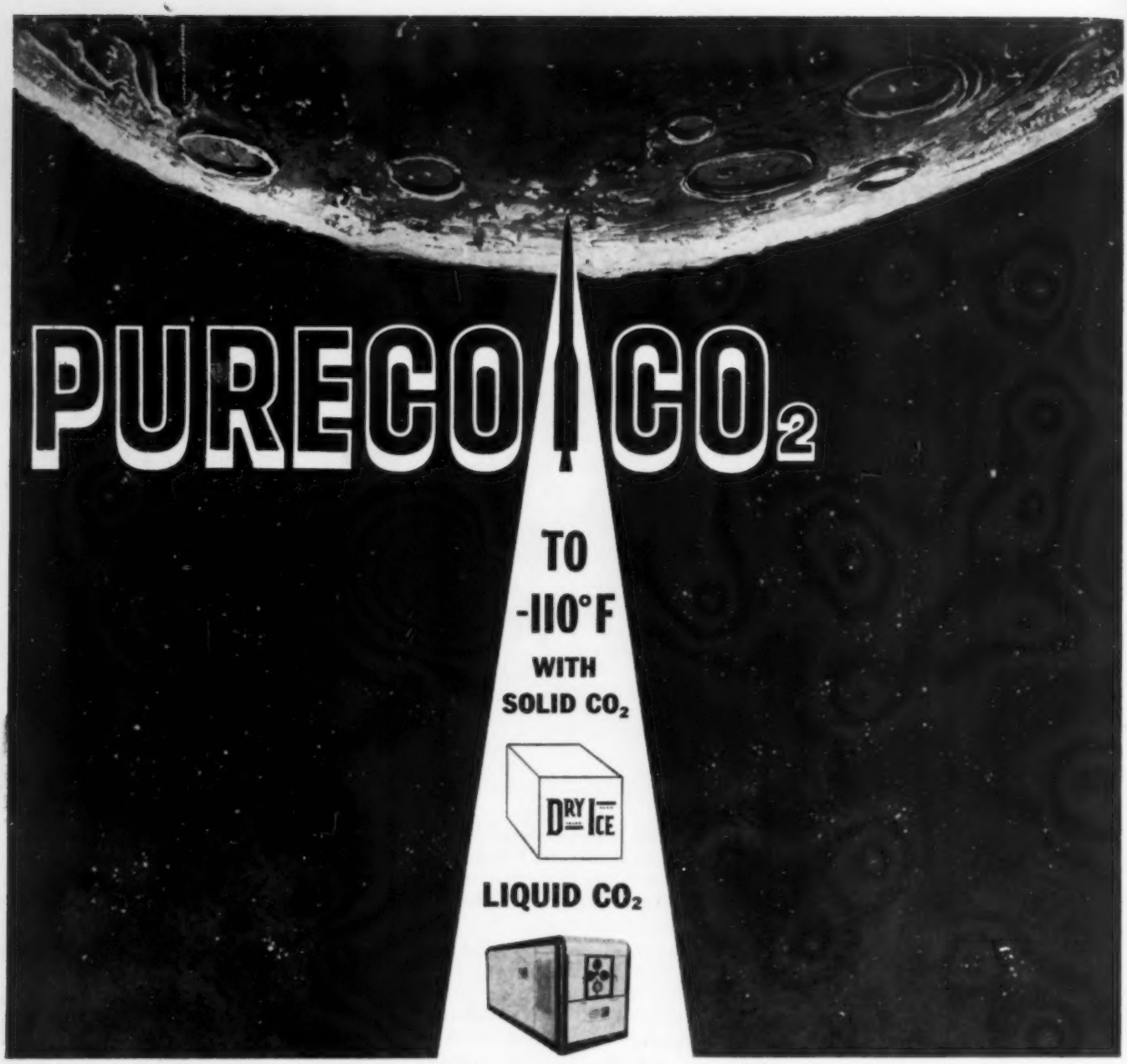

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Hughes Aircraft Gets $30 Million Contract

The U.S. Army Signal Corps has awarded a $30,689,713 contract to Hughes Aircraft Co. for production of elements of "Missile Monitor" air defense systems for use by a field army.

Designated AN/MSQ-18 by the Signal Corps, the system is the operations control center at battalion level for overall mobile defense operation attached to an army in the field.

MSQ-18 systems will tie in and coordinate airborne target information from existing U.S. Army radar to existing missile batteries. It will insure maximum efficiency and employment of such Army antiaircraft units as the *Nike* and the *Hawk*.

Production will take place at Hughes' Fullerton, Calif., plant. The contract will involve a monthly payroll of $800,000 at Hughes; $125,000 monthly external purchases in the Los Angeles area; and employment of approximately 1,600 people at maximum production. An additional 250 employees working for sub-contractors will participate.

GE Shows "Plasma Accelerator" Control

Further progress in the plasma jet field was indicated at the Air Force Association Convention in Dallas, when General Electric unveiled a working model of what it calls a "pulsed plasma accelerator." The accelerator can be used to control the direction of space craft in their flights through space. (See m/r Sept. 29, p. 11.)

The accelerator, which is one of several types being developed by GE, was built by GE's Aerosciences Laboratory in Philadelphia. It uses the magnetohydrodynamic principle to propel a low density gas at high specific impulses.

Inside a T-shaped glass tube, with its normally horizontal cross-arm in a vertical position and the vertical arm extending into an evacuated chamber, a plasma is formed and discharged into the chamber.

The plasma, composed of ionized gas, is produced by a hot electric field generated by regularly occurring sparks between brass electrodes. The current is returned through a brass strap outside the glass tube, setting up a magnetic field to help propel the plasma out the tube into the chamber.

The evacuated chamber, designed to approximate the vacuum conditions of outer space, is made in a bell jar.

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Circuit Development Group Leader Ralph Wolcott (left) considers future changes in computer output unit for bombing—navigational systems.

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Project Engineer Robert J. Cantwell (left) uses a system of gimbals to describe navigational problems in the analysis of a new system design.

Staff Engineer William Howard (center) reviews gearing accuracy requirements of test equipment with electronic circuit designers.

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Space Team Must Include Skills of Basic Sciences

U.S. efforts will need top brains to meet challenge posed by non-military vehicles

by L. Eugene Root

L. Eugene Root, a nationally recognized missile scientist, heads the Development Planning Dept. of Lockheed Missile Systems Division. Root's group advises management on directions of development, trends in power and utilization of scientific advances in various fields. The following article was presented at a recent meeting of the Northern California Branch of the American Astronautical Society.

The development of astronautics, carried along on the back of the guided missile, makes a good story: the German pioneers of the Interplanetary Society struggling along with their small-scale experiments, until they were picked up by the German Defense Ministry and deposited in Peenemunde with the vast resources that perfected the V2 missile—but still dreaming of the conquest of space.

Then the sequel, after World War II, when the national and technical resources of the U.S. were brought into the further development of the ballistic missile; providing the powerful engines, the guidance techniques and hypersonic know-how with which the exploration of space could finally be started.

There is a third chapter which tells how Russian ballistic missile development followed the same course, arrived at an orbiting capability at about the same time, and turned the pioneering exploration of space into a kind of gold rush, 1957 version.

Let us now examine the part industry should play in the next few years, now that astronautics has become an important technology in its own right.

Evidently, we are now past the time when astronautics made progress only by the fortuitous coincidence with ballistic missile development; in fact, there are many of us who now anticipate a divergence between the future paths of development of the ballistic missile and the space vehicle.

In particular, the differences arise mainly from the small size of the earth and the large size of the universe. On the earth, for example, there are no radio communications circuits which are expected to work over distances longer than about 5,000 miles; a radio communications circuit, even to a moon vehicle, would involve distances 50 times greater. Thus, taking into account the inverse-square law, the difficulty of radio communication is increased by about three orders of magnitude.

For planetary distances, the problems concerned become even more impressive. For journeys outside the solar system (supposing we knew how to make them) we should find ourselves in a totally new regime.

•Military objectives limited—Again, considering the minuteness of the earth and the vastness of outer space, we find that the requirements on military missile performance are strictly limited by the short range of the longest significant mission.

A military missile is required only to propel itself from one point on the surface of the earth to another. Taking the long way around, this involves a 20,000-mile journey, all of which is accomplished in a strong gravitational field and in a dense atmosphere. Under these circumstances, the requirements for propulsive devices involve high thrust for short periods of time.

For the long missions of space travel, engines of very low thrust but high specific impulse may well turn out to be most useful. There is presently no known economically feasible way to design and develop such engines, even though military use can well be visualized.

The same general remarks apply to other important fields of technology; to guidance, to navigation. They apply to the developments necessary to enable men to live in the new and largely unknown environment of space, outside of the protective envelope of the atmospheric ocean.

• Still exploratory—During these years astronautics will be almost certainly in the exploratory stage. We shall be learning how to live, how to adapt ourselves, our instruments, and our habits and customs, to the new environment. When we talk of the exploration of space we imply exactly the same kind of adventure that has stimulated all exploration—the challenge of the unknown. It is of course this challenge which explains the tremendous current popular interest in astronautics.

Ever since the disappearance of our Western frontier, we have looked for some substitute for the old adage "Go West, young man." And here it is, in the conquest of space, an unprecedented technical challenge with overtones of international rivalry.

Even at ground level, the pattern of exploration has been changing greatly during the last few years. The individual explorer, who vanished for ten years into the wilderness and came back with fabulous tales, has now gone forever.

If you look at our recent attempts upon the last remaining frontiers on earth—for example, at the present South Polar expeditions involving the military, scientific programs, private industry and individual specialists; or the conquest of Everest by Hillary's team—you will realize that exploration is now a concerted team effort, rather than a matter of individual and personal accomplishment. This is an indication of the obvious fact that modern techniques for exploration now demand more skills, more specialized knowledge and

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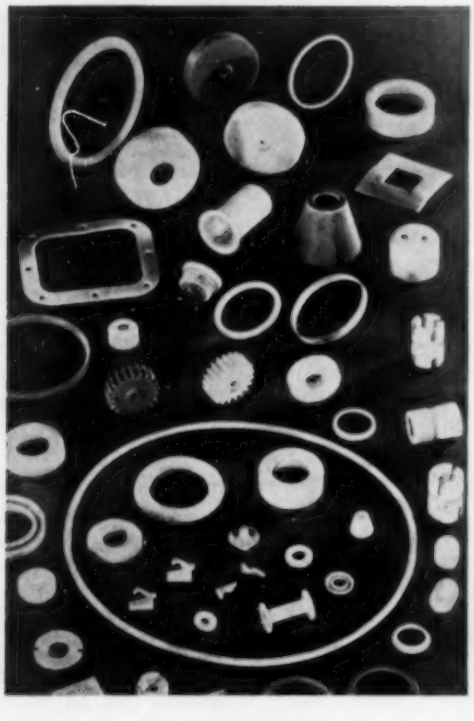

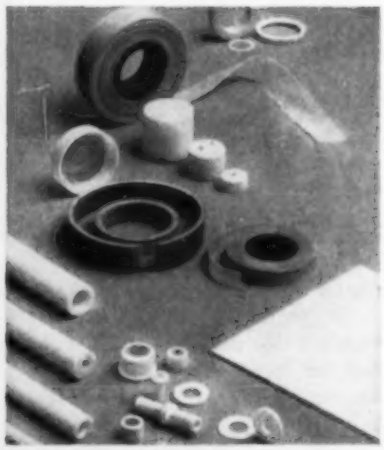

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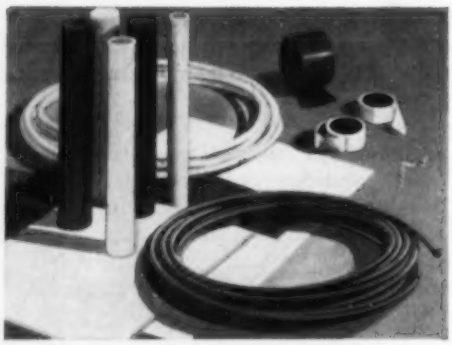
We understand the complexities of your problems—friction, extremes of temperature, the corrosive action of exotic fuels, etc.—and will give you all possible aid in designing, molding or machining the R/M parts or components you need. Make R/M your headquarters for all the "Teflon" products you need. Call upon your nearest R/M district office for the cooperation you require—or contact us direct.



R/M "Teflon" products for the aircraft, missiles and rockets industries include flexible wire braid covered "Teflon" hose; "Teflon" sheets, tape, rods and tubes; rods, sheets and tubes in certified and stress-relieved grades (X-ray films for sheets and rods are available); centerless ground rods held to very close tolerances.

* *A Du Pont trademark*

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Circle No. 26 on Subscriber Service Card.

. . . space team

abilities than we can expect to find, by any standards in any single individual.

• **Team job**—Modern exploration requires a team—and the care with which the team is selected, their original competence and their effective training, and the smoothness with which their individual contributions can be meshed together, are the things which determine the success in attaining the goal. The functions of organization, of guiding the team effort so that every member is contributing his maximum, are all-important.

It is important to emphasize here that the growth of the explorer team has not reduced in any way the requirement for intense individual effort from the team member. Nor should it diminish the personal incentives, or the sense of individual accomplishment, which every member of the team must be able to feel when the goal is reached.

• **Industry role**—The role of industry in the exploration of space is now very evident. More than any other mission upon which we are now engaged, the development of space flight will require team effort during the exploratory stages that must be completed in the next few years.

The groups which the missile industry has assembled are of course the most obvious source for such a team; and in particular, the industrial teams which have, during the past three or four years, developed the rocket-propelled ballistic missile appear to combine many of the special skills which are critical in the exploration of outer space.

When I talk about an industrial team in this way, I am not referring only to the accumulation of specialists within the organization of a prime missile system contractor. I am including also the complete system of links which we have forged, by personal contact, or by subcontract, which permit us to draw upon the whole resources of our government research laboratories and our industrial specialists throughout the country.

• **Special skills**—What are the specialist skills which should be gathered together in such a team, to permit it to advance most rapidly in the exploration of space? Dr. von Karman has discussed this question quite recently. In a recent address to the AIA, he stressed the fact that the "foundation" sciences of aeronautics—the mathematics, physics and chemistry underly-

ing our rapid advances in airplane structures, propulsion and dynamics—are still the major contributors to flight in space and successful return to the earth.

Problems of navigation, of conditioning of the environment, particularly for the human occupant, represent considerable extensions of our developments for airborne vehicles; but they *are* extensions, it must be remembered—not fresh starts.

Dr. von Karman's speech was, in fact, a request to apply to space flight all the know-how which we have accumulated in our present more restricted flight, and not to shoot off enthusiastically re-discovering things in all directions (as we occasionally have a habit of doing!).

An even more important question is: what does our individual team of explorers currently lack which might jeopardize the success of the mission? In reply to this question, I'm not going to say "We have it all." We don't! Many of the answers we want can only come from a good astronautical research and development program; and we cannot expect to make up the deficiencies of years of inadequate effort by a sudden spurt, lasting only a few months.

• **Information needed**—Even now, after all the clamor throughout the country for accelerated space research, we are getting back from space only a small fraction of the environmental information which our competitors are obtaining from *Sputnik* III. We *must* put more effort on getting back data from space, so that we can find the answers.

We are also lacking in research facilities. As an example, we has been working for some time in the problems presented by space structure; structures which have to carry no weight and yet need cope with no aerodynamic drag.

The most efficient constructions for these conditions are light and thin; they may not even support their own weight on the ground. How do we check out such structures on the ground before putting them into orbit? There does not exist at present any facility which would enable us to do this; and what is worse, there are very few ideas about how to make such a facility.

It is quite possible that the next research laboratory to be built by the U.S. government will be on an elongated elliptical orbit. I'm sure that there are many who would be very willing to participate in the building of this laboratory. ★

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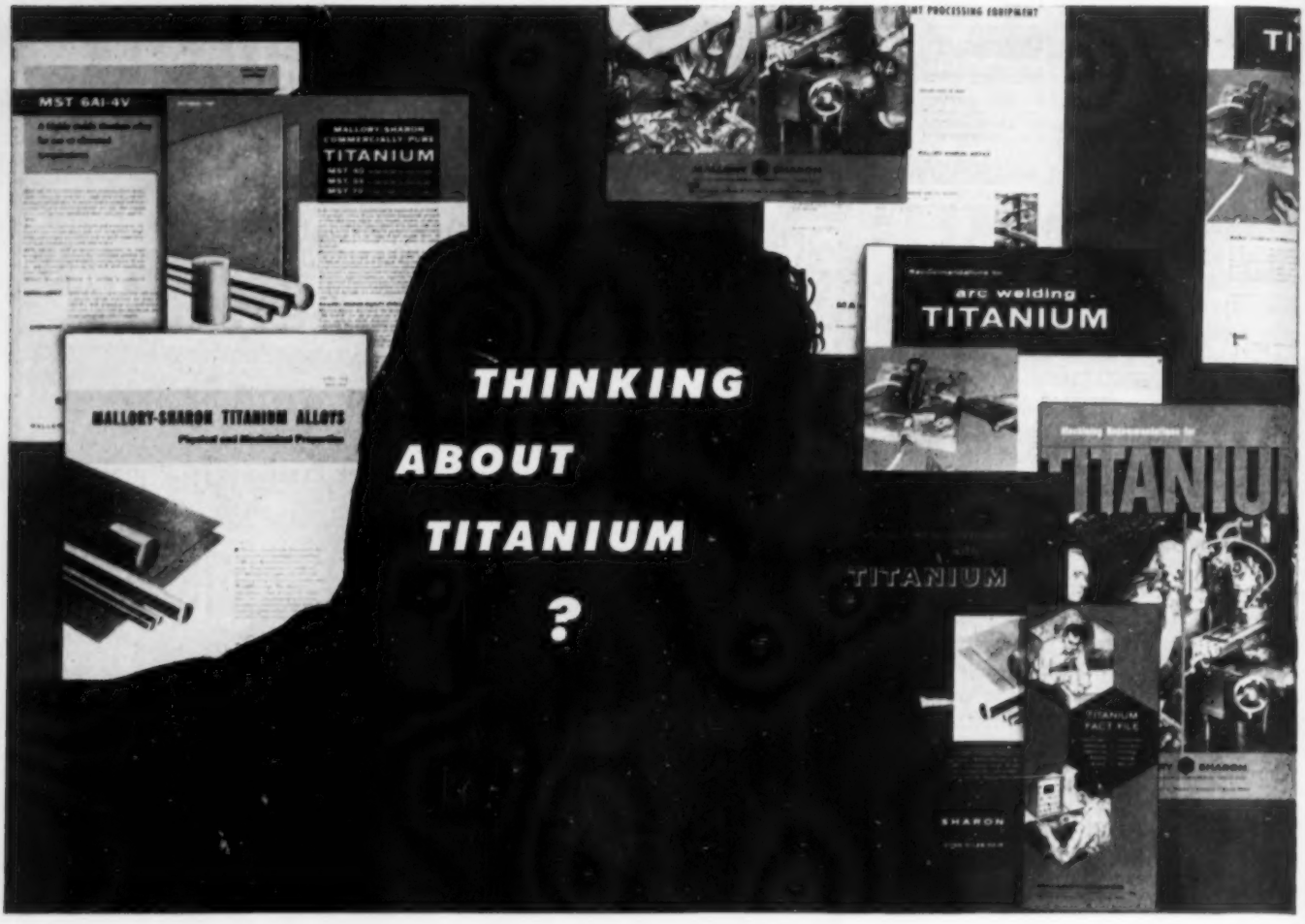

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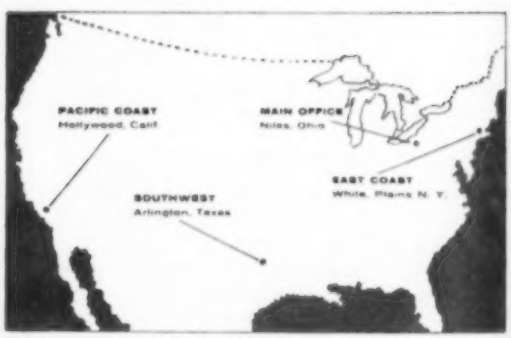

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Circle No. 14 on Subscriber Service Card.

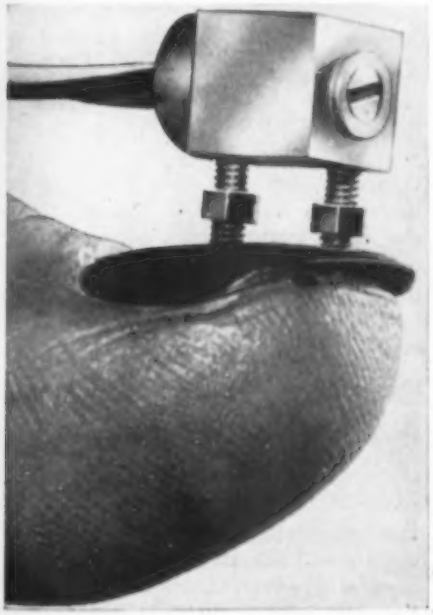
Potentiometer Unit Has Oil Bearings

A sine/cosine potentiometer for use in radar, computer and servo-mechanism assemblies is now available from **Clarostat Mfg. Co., Inc.,** Dover, New Hampshire. The new unit has a standard conformity of plus/minus 1% peak-to-peak, or a special conformity of plus/minus ½% peak-to-peak.

The Clarostat sine/cosine potentiometer employs oil-impregnated bronze bearings for a recommended maximum speed of 30 RPM. Precise windings, plus a low-wear wiper design, results in a guranteed life of 500,000 cycles. The unit has a flange mount, with a diameter of 2.050" and 1.925" diameter beyond. Shaft torque is 1.0 oz./in.

Circle No. 225 on Subscriber Service Card.

Trimmer Potentiometer Designed For Extremes



Designed for horizontal-mounting applications, these trimmer potentiometers which measure only ¼ inch square by 3/8 inches long are engineered and tested for operation under environmental extremes of heat, cold, humidity, vibration and shock.

Available for stud-mounting (Model MS-4) and lead-mounting (Model MS-5) on printed wiring boards, both models feature low temperature-coefficient resistance wire, precious metal wiper, Mylar and Teflon insulation.

The units, developed by **Miniature Electronic Components Corp.,** are rated at ¼ watt and are available in standard resistance values from 100 ohms to 10,000 ohms.

Circle No. 226 on Subscriber Service Card.

Transistorized Chopper Designed as Modulator

Model 60 transistorized nonmechanical chopper, announced by **Solid State Electronics Co.,** Van Nuys, California, features small size, ¼" dia. x ½" long, and is encapsulated to withstand shocks of 2,000g for 11 msec, vibrations of 30g up to 2000 cps and acceleration of 5,000g.

It is designed for use either as a

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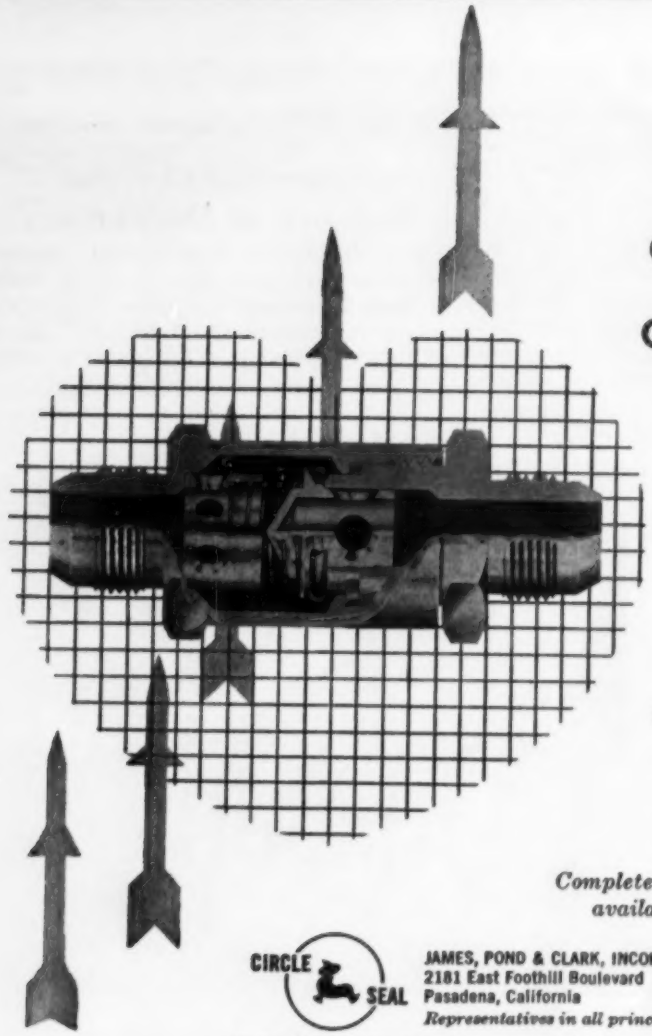

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modulator or a demodulator and being an inertialess device it can be driven from d.c. to hundreds of kilocycles, symetrically, nonsymetrically or randomly. The switching circuitry provides stability and freedom from drift over a wide temperature range, –40°C to +80°C. Weight is one gram.

Circle No. 227 on Subscriber Service Card.

Variable-Delivery Pump Halts Turbine Stall

A variable delivery pump incorporating torque-limiting features has been announced by **Vickers Inc.,** Detroit, a division of Sperry Rand Corporation. The pump was designed for emergency ram air hydraulic and alternator drive applications. It prevents turbine stall due to pump torque requirements at start and at low air speeds.

The pump produces full outlet pressure (3,000 psi) at all turbine speeds and pump torque demand always remains within the turbine's capacity to supply torque. These conditions are met by limiting the pump's yoke position and flow rate during low rpm operation. To meet high flow requirements during low turbine speed, the pump automatically adjusts to permit increased flow at reduced system pressure.

Circle No. 228 on Subscriber Service Card.

Cathode—Ray Oscilloscope Retains Pictured Images

A new cathode-ray tube oscilloscope, with a special screen phosphor that records and retains a picture for days, has been introduced by the Industrial Products Division of **International Telephone and Telegraph Corporation.**

The new instrument, called the "Storascope", was demonstrated for the

first time recently at ITT's exhibit at the WESCON show in Los Angeles.

The "Storascope" is designed for recording transient pulses, and signals recurring regularly or irregularly at frequencies up to 10 kilocycles. Although the picture will remain visible for days, it may be erased in 20 seconds and the screen is immediately ready for new recordings after the erasure. Through the use of an automatic line-switching arrangement, the 3½" x 5" screen will record either enlarged single traces or ten traces in succession on ten separate lines.

The instrument is 11" wide, 15⅜" high, and 19¾" deep. It weighs 44 lb.; has a separate power supply measuring 6⅜" wide, 11" high, and 13" deep. The supply weighs 25 lbs.

Circle No. 229 on Subscriber Service Card.

Fasterner and Bushing Offers Lowered Cost

A compression-type fastening is designed to affix or hold tubing, pipe, cable, or wire firmly immovable and also to fasten it to a panel or wall. The Barr Bolt is called less expensive than conventional approaches to this problem, and is developed by **Barr Machine and Tool Division,** Denver Metals and Chemicals Corp.

A threaded hollow bolt, which may be serrated inside for greater gripping action, features an elevated key. The tubing or cable is inserted through the Barr Bushing. The Bushing is inserted through the panel or wall to which the tubing or cable is to be attached. When the nut, which will hold the assembly to the panel, is screwed on, it depresses the key, causing compressive action on the tube or cable, holding the tube in place. At the same time, the nut affixes the assembly to the panel. Adjustment of the throw will give load pressures of any desired compressive force, according to the manufacturer.

Circle No. 230 on Subscriber Service Card.

Timing Signal Amplifier For Data Transmission

Nems-Clarke Co., Silver Spring, Md. announces the availability of its Type TSA-100 Timing Signal Amplifier, designed for distribution service in data transmission systems.

This is a fully transistorized, wide brandwidth power amplifier having fre-

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for rocket and jet engines

—measure fuel, oxidizer, and combustion pressures during static firing tests.

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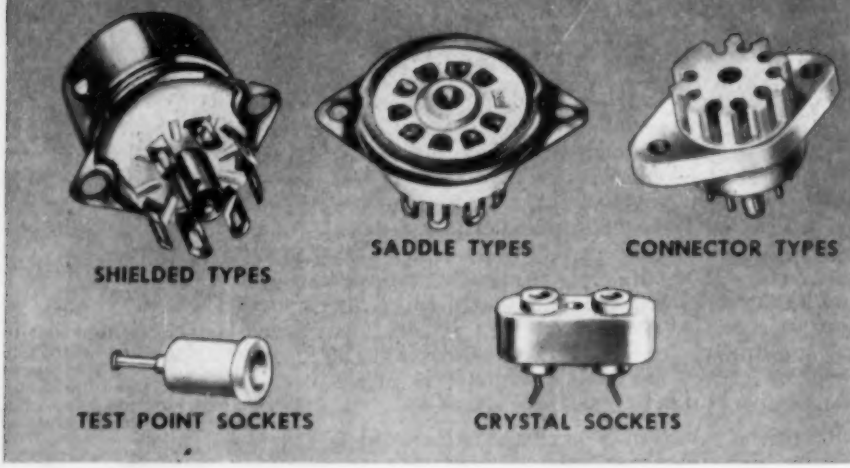

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Complete variety in standard and assembly-cost saving compression mounting types. TEFLON insulated, with all metal parts and finish to JAN specifications. High reliability factor—withstand mechanical shock, vibration, high temperatures. Low loss insulating qualities, zero moisture absorption. Non-tracking arc resistance. Non-DC plating. Great weight savings (sub-miniature tube socket, for instance, weighs only .04 oz.). Catalog EC-358. Fluorocarbon Products, Inc., Division of United States Gasket Co., Camden 1, N. J.

*du Pont trademark

Fluorocarbon Products Inc.

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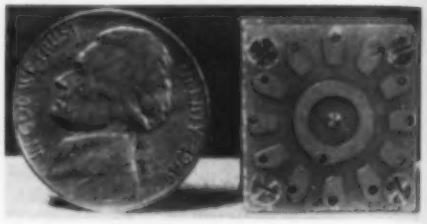
. . . new products

quency response from dc to 50 kc at full output of 5 watts, peak. At reduced power output the response extends from dc to 180 kc.

This wide frequency coverage can provide for the re-establishment of signal and power levels of a wide variety of pulse and analog data signals. The unit accepts either balanced or unbalanced inputs and amplifies these signals to deliver 5 watts into a 150-ohm balanced load. The power supply for the unit is self-contained. The amplifier occupies 3½ inches of rack space.

Circle No. 231 on Subscriber Service Card.

Microminiature Switch Has Twelve Positions



A microminiature 12-position switch with positive interlock and low rf loss for switching from DC to hundreds of megacycles has been announced by **Avion division, ACF Industries, Inc.,** 11 Park Place, Paramus, N. J.

Contact points are gold plated, with an ungrounded isolated center shaft and flush mount for control space. It is designed for any purpose, including meter, band and function switching or sub-miniature ground or airborne radio frequency systems.

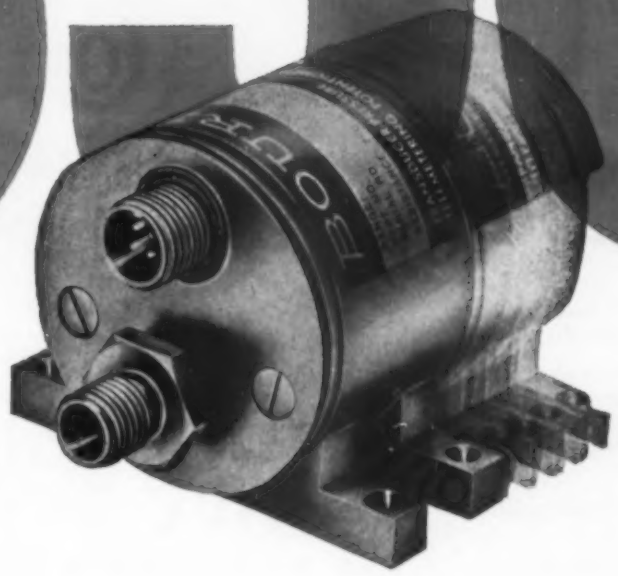
Circle No. 232 on Subscriber Service Card.

Transistors Protected Against Interference

Development of a new instrument, designed to protect transistor circuits from high-voltage transients, is announced today by the **Engineered Magnetics division** of Gulton Industries, Inc.

The transient eliminators are being produced in two models, EM 446 for

35G



NEW PRESSURE TRANSDUCER: LOW VIBRATION ERROR AT 2000 CPS, 35G

Combine this with 0.17% resolution and you have truly remarkable performance. What's more, this new Model 717 Absolute Pressure Transducer is *in volume production* in ranges up to 4,000 psia.

Simplicity is the keynote—an entirely new type of Bourdon tube instrument eliminates linkage systems. There is only one moving part in the unit, and static friction is less than resolution. Over-all result: excellent performance during high vibration—static error band of ±0.8% (linearity, hysteresis and repeatability).

New concepts in basic design are being combined with high performance in new Bourns accelerometers, pressure transducers, linear motion potentiometers, and other electro-mechanical devices. When your requirements need the experience of a leader—look to BOURNS.

Write for detailed technical information on Model 717

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MISSILE COMPONENTS Bulova safety and arming systems protect ground, air and sea crews from load to launch, then take over in flight. Safety factor of one in a million is specified and reliably delivered by Bulova's precision production facilities. Powder-driven gyros and fuzing systems are among other Bulova developments for 18 key missiles.

AIRCRAFT INSTRUMENTS Bulova's new Servo Altimeter assures maximum reliability through unprecedented sensitivity, accuracy and repeatability. At 40,000 feet, it detects 4-foot changes . . . is correct to 40 feet. Safety is improved in traffic control and flight over difficult terrain. As a control instrument, it is readily adaptable to guided missiles.

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INFRA-RED COMPONENTS Bulova infra-red cells are designed to unerringly guide Sidewinders to target. Bulova-improved production processes increase yield and product reliability. Other infra-red developments include filters, reticles and thermistor bolometers, as well as advanced research in mosaic and lead selenide cells.

PHOTOGRAPHIC SYSTEMS Bulova's new high performance 70mm recon-camera features 8 frame/sec. and pulse operation...vibration-free exposures to 1/4000 sec. From the smallest 16mm gun camera ever built to units of 9x18" format size, Bulova developments include optical, data recording and instrumentation, and special sequence cameras.

Engineers and Designers interested in creative opportunities are invited to submit their qualifications to Dr. R. Hershey, Personnel Mgr., Bulova R&D, 62-10 Woodside Ave., Woodside 77, N.Y.

Circle No. 15 on Subscriber Service Card.

airborne applications, and EM 472 for use in laboratory and ground support equipment.

The new transient eliminators when placed in series with power sources, absorb high-voltage transients and prevent their appearance at the output of the elimination thus protecting the transistor load.

Both units are rated for continuous operation at 32 VDC and 15 Amps., and satisfy military specifications, MIL-E-5272. Other outstanding features are portability, lightweight, short circuit proof, high reliability, no stand-by power and little line drop. The units are protected against reversed polarity, inductive kick-back and over-voltage.

Circle No. 233 on Subscriber Service Card.

Noncontacting Gage Checks Material Properties

Gammascan, a new noncontacting gage has been put on the market by **Nuclear Systems,** a division of the Budd Company. The machine continuously measures the thickness and density of materials through the use of gamma radiation.

The gammascan's thickness capability ranges from light gage metals to more than a foot of steel or equivalent. The machine can inspect a wide variety of products such as rolled sheet steel, extruded forms and solid fuel for missiles.

In operation, gamma radiation from the machine's throroughly shielded Cobalt 60 source passes through the material being inspected to a scintillation detector which converts the radiation to an electrical current. Variations in this current are interpreted by the gammascan as changes in material thickness or density.

Gammascan's output is indicated visually on a meter calibrated in thickness increments and can be fed to a

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PROPULSION SPECIALIST—Familiar with gas dynamics and thermodynamics of nozzle flows and combustion of solid and liquid propellants.

INFORMATION THEORY ANALYST—Experienced in mathematical analysis of mechanical and electromagnetic transmission of information.

PHYSICIST—Familiar with the physics of gases and liquids, mechanical and electromagnetic wave propagation within these media.

SOLID STATE PHYSICIST—To work on electronic elements.

MAGNETO HYDRODYNAMICIST—To work on advanced propulsion systems.

APPLIED MATHEMATICIAN—Experience in logical programming of systems and interest in communication and probability theory.

Your complete resume should contain personal, educational, experience data, and salary requirements. Send to DIRECTOR OF PLACEMENT. All replies will be held in strict confidence.

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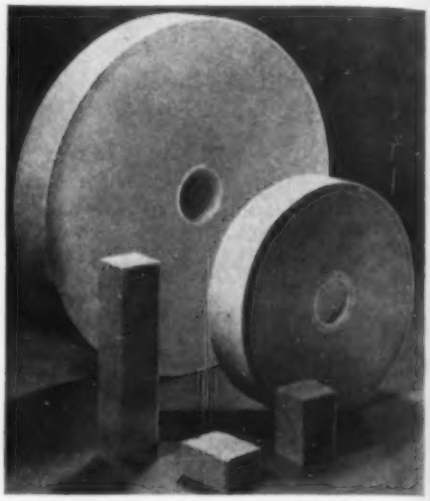
Thin-walled Ceramics for High-Temperatures



Extremely thin-walled ceramics formed into lightweight honeycomb structures, said to be capable of operating at high temperatures have been introduced by **Corning Glass Works.**

These materials, male by the new Cercor process, can withstand temperatures up to 1,000 C (1800 F) with virtually no thermal expansion, and can operate continuously at 700 C (1290 F). At these temperatures they are resistant to oxidation and corrosion.

A unique characteristic of these materials is their extremely low coefficient of thermal expansion—1 x 10-7 per degree C (from 0 to 300 C). They can withstand extreme thermal shock.

Available Cercor pieces have a compressive strength, parallel to the channels, of 2000 psi. Surface area of the 20-hole-per-inch corrugated structures is 1500 square feet per cubic foot of material.

Circle No. 235 on Subscriber Service Card.

220,000 psi Locknuts Offer High Strength

A new series of high strength, double-hex, external wrenching, self-locking nuts is now offered by the **Elastic Stop Nut Corp. of America** for advanced design high tensile bolting requirements. Design refinements are said to consistently develop the full fatigue strength of 220,000 psi bolts.

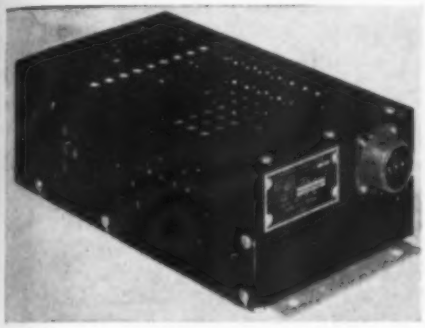
The new type LG3393 high tensile nuts offer the required performance characteristics, yet the manufacturer asserts they are from 10% to 33% lighter, size for size, than even the

lightest 180,000 psi locknut. Further weight saving is made by the smaller envelope dimensions of the new parts, since reductions of the wrench clearance requirements permit reductions in the size of other structural components.

The new high tensile nuts are cold formed from alloy steel, cadmium plated with a supplementary molybdenum disulphide dry film lubricant. Presently available in thread sizes ¼-28, 5/16-24, ⅜-24, 7/16-20, larger sizes are now in design.

Circle No. 236 on Subscriber Service Card.

Static Inverter Handles Single and 3-Phase



The **Varo** Model 4309 static inverter is said to produce both single phase and three phase 400 cycle power from 28 VDC input. A Varo bimetalic tuning fork reference controls the frequency to 400 cps ± 0.1% over the environmental range of −55°C to +71°C.

Utilizing transistors in a bridge switching circuit for maximum reliability, 170-210 VA of single phase power and approximately 50 watts of three phase power are obtained from a unit weighing only 9½ pounds. The design of the bridge inverter is such as to allow operation to 71°C without heat sinks or cooling air. It also enables the unit to operate with up to 35 volts input for short periods of time.

Circle No. 237 on Subscriber Service Card.

Magnetic Read Head For Control Systems

A new 83-Channel per inch magnetic read head has been developed in **Stanford Research Institute's** Control Systems Laboratory. The read head promises to be useful with magnetic drums, magnetic tape transports, facsimile and other applications.

The crosstalk between adjacent channels is down by more than 20 db in the present head, and is negligible between non-adjacent channels.

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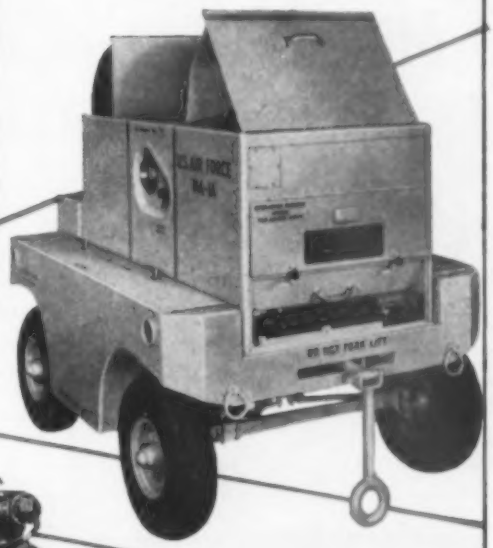
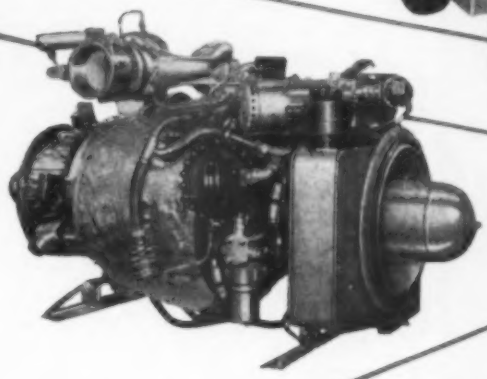
NOW IN VOLUME PRODUCTION AT C.A.E.

...PNEUMATIC GROUND SUPPORT for the JET AGE



MODEL TC106
(USAF TYPE MA-1A)



MODEL 141
TURBOCOMPRESSOR
ENGINE

Typical of the fine results of Continental development is the TC106 trailer-mounted, portable gas turbine compressor unit suitable for starting large jet engines and ground check-out of air conditioning and cabin pressurization systems. The hot discharge air blast can also be used for other purposes such as removal of ice and snow from aircraft surfaces. This advanced model, built around its dependable Model 141 turbocompressor engine, features high performance, excellent mobility, low noise, and a completely automatic control system. This pneumatic compressor package can also be furnished without the trailer for any custom-engineered installation. . . . It is now in volume production at Continental's Production Division, Toledo, Ohio.

CAE turbojet engines—the J69-T-9, the J69-T-2, and the J69-T-19B are in volume production for the Cessna T-37A twin-jet trainer, the Temco TT-1 jet trainer, and the Ryan Q-2A Firebee target drone respectively.

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TITANIUM?
STAINLESS?
ALUMINUM?

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CAN
WORK IT

HOUSINGS
COMPONENTS
SUB-
ASSEMBLIES

Kaman craftsmen are experienced in all phases of aircraft techniques from the small sub-assembly to the complete air-frame. They are eminently qualified to make assemblies controlled to rigid specifications from the drawing to the finished product, complete with installations. Much of their experience has been with the aircraft metals and the so called "hot" metals. Currently they are producing housings for airborne electronics as a part of several missiles and rockets programs.
Have you considered Kaman? Write for equipment list and illustrated facilities brochure to J. W. Marshall, Manager.

SUBCONTRACT DIVISION
THE KAMAN AIRCRAFT CORPORATION
BLOOMFIELD 9 CONNECTICUT

Circle No. 35 on Subscriber Service Card.

missile business

by Fred S. Hunter

Big personnel procurement pitch on the west coast currently is slanted toward electronics. If you can qualify in this field, you've got it made.

Take the top jobs advertised by one Los Angeles placement agency, four positions at $30,000 per annum. All except one require a Ph.D in electrical engineering. The exception is for a Ph.D, too. Any kind of a Ph.D, apparently.

A recent Los Angeles Sunday paper had 12 pages of help wanted advertising, most of it for engineers and scientists allied to electronics or some facet of missile design and development. Imagine running a help wanted advertisement for a scientist. It's happening every day in Los Angeles.

Company doing the most personnel procurement advertising at this time is Lockheed for its Missile Systems Division, with openings available at Sunnyvale, Van Nuys and Santa Maria. Latter means Vandeburg Air Force Base and the Pacific Missile Range. Lockheed's MSD lists about 25 job categories where shortages exist and 90% of the areas involve electronics.

Other companies advertising heavily in the Los Angeles market: Hughes Aircraft Co., (both for its Culver City and Fullerton plants); Space Technology Laboratories (Ramo-Wooldridge); Systems Development Corp. (Rand); Aerojet-General Corp., (for Azusa and Sacramento); Douglas-El Segundo; Northrop Aircraft (Nortronics division); General Electric (for Tempe, Ariz.); RAC, and Marquardt Aircraft Corp. (for Ogden and Van Nuys). In practically every category, electronics and/or missiles are involved.

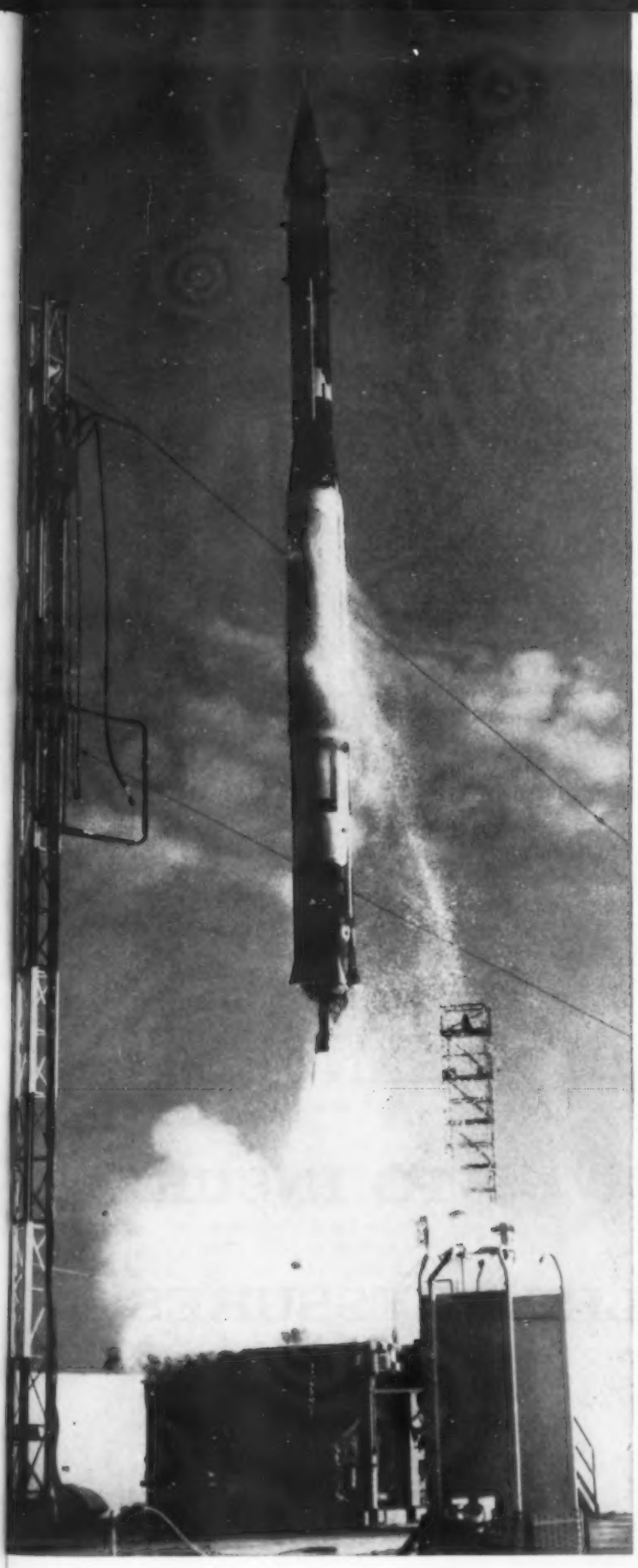
There is a great deal of demand for experts in reliability, a rather gratifying thought. Considerable searching is being done for computer programmers or for trainees in this field, a hard one to fill at the moment.

Aerojet-General's $19.3 million order from the Navy to build the hydrodynamic frame of a high speed torpedo, as well as the propulsion system, may provide an opportunity for the rocket manufacturer to show what it can do in explosive metal forming, or aeroforming as it is called. The navy is highly interested in developments in this method of fabrication, and has been conducting studies at China Lake for about nine years. Aerojet is very active and has a proving ground at Chino, where recently it conducted its 10,000th test firing.

The rocket industry is heading toward unusual shapes and large dimensions where conventional deep draw and spinning methods won't suffice. Explosive forming may be the answer. Aerojet currently is working on the forming of pressure domes that may be used in missile production.

In this process, a large metal bowl-shaped portable mold is backed in concrete. The blank to be formed is secured over the mold, after which an explosive charge is suspended above it. A vaccum is created in the mold, the entire unit is lowered into a tank of water and the charge detonated. Water pressures from the explosion forms the blank. Aerojet says this new fabricating process, although still in experimental stages, shows signs of having a bright future.

Company notes—Air Force Sales Unit of **GE's Heavy Military Electronics Department** set up an advanced development sales organization, to aid military customers in keeping track of GE activities . . . **Growth Industries Group, Inc.,** designed to supply management skills, organized in New York City.



Successful Vanguard equipped with Union miniature relays

March 17, 1958—Union Switch & Signal 6 PDT miniature relays functioned perfectly in the separation controls between the first and second and second and third stages . . . in the first stage propulsion unit . . . and in the third stage spin control assembly of the satellite-bearing Vanguard.

The Martin Company, builders of the Vanguard, chose these outstanding relays for their reliability . . . for their simple, rotary design . . . and for the expert quality control associated with the established leader in electrical relay design—Union Switch & Signal.

The 6 PDT relay used in the Vanguard is just one of a complete line of *dependable* relays designed by Union Switch & Signal—"Pioneers in Push-Button Science." Send the coupon for complete technical information.

COMPLETE FACTS

Union Switch & Signal, Adv. Dept.
Pittsburgh 18, Pennsylvania

Please send information on the following:

- ☐ New 4PDT relay which meets every requirement of MIL-R-25018.
- ☐ Catalog of other miniature dc and ac relays.
- ☐ Digital and Alpha-Numerical Indicators for data display.

Name _____ **Position** _____

Firm _____

Address _____

City _____ **Zone** _____ **State** _____

"Pioneers in Push-Button Science"

UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

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contract awards

Arthur D. Little, Inc., received $40,-

new horizons for dim light photography and television...

SUPER FARRON F/0.87

76MM • 30° FIELD
40MM FOCAL PLANE

Super-Farron — an ultra high speed photographic objective having extremely fine correction over an unusually wide flat field. The advantages of its photographic speed of T/1.0 for operation under adverse light conditions are evident. It is available with standard infinity correction for direct photography, and it can be supplied corrected for 16:1 or 4:1 conjugates for special purposes. The Super-Farron is eminently suitable as an objective for Image Orthicon television cameras or for special 35mm photography.

Technical data available on request
Specify Engineering Report No. 327

Pat. No. 2,846,923

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Engineers, Designers and Manufacturers
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HAVE UNIQUE BALANCED

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CONSTANT FLOW VALVES
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Circle No. 18 on Subscriber Service Card.

contract awards

ARMY

By Ordnance Disrtict, Los Angeles:

Hughes Tool Co., Culver City, Calif., received $142,117 for development of devices to produce nuclear environments.

North American Aviation, Inc., Canoga Park, Calif., received $50,000 for rocket engines.

Gilfillan Bros., Inc., Los Angeles, Calif., received $124,048 for requirements of spare parts for the *Corporal* missile system.

Firestone Tire & Rubber Co., Los Angeles, received $163,031 for concurrent repair parts for *Corporal* missile.

Douglas Aircraft Co., Inc., Santa Monica, Calif., received $45,251 for repair parts for the *Nike* system.

Douglas Aircraft Co., Inc., Santa Monica, Calif., received $64,074 for repair parts for the *Nike* system.

By San Francisco Ordnance District:

Lockheed Aircraft Corp., Lockheed Missile Systems Div., Sunnyvale, Calif., received $64,954 for feasibility study for target missile system.

By Engineer District, Jacksonville, Corps of Engineers:

Diversified Builders, Inc., Patrick AFB, Fla., received $195,000 for construction of addition to engineering and lab building, Cape Canaveral Missile Test Annex, AFMTC.

By Corps of Engineers, Office of the District Engineer:

Shelby Electric Co., Inc., Memphis, Tenn., received $239,967 for installing controls and instrumentation for coolers nos. 2 and 3 for the supersonic circuit of the propulsion wind tunnel.

By New York Ordnance District:

Western Electric Co., Inc., received $2,200,000 for production engineering services for the preparation of ordnance documentation for the *Nike-Hercules* guided missile system.

Chrysler Corp. received $27-million for producion of *Redstone* missiles and components.

AIR FORCE

Extrusions, Inc., Caldwell, N.J., received $85,780 for development of a process for the extruding of titanium and steel alloys by use of explosives.

Titanium Metals Corp. of America, New York 7, N.Y., received $121,208 for development for an improved method for mechanically removing the oxygen—rich contaminated surface layer resulting on titanium alloys after exposure to air at elevated temperatures.

By AMC HQ:

Vitro Engineering Co., Vitro Corp. of America received $2,627,332 for maintentance and operation of SAGE utilities sysetms.

Vinnell Co., Inc., received $1,005,919 for maintenance and operation of SAGE uitlities systems.

RCA Service Co., Radio Corp. of America, received $361,564 for maintenance and operation of SAGE uitlites sysetms.

Aircraft Gas Turbine Division, General Electric Co., received $66,511 for research on "Radiation in Rocket Motors."

Arthur D. Little, Inc., received $40,665 for continuation of research on "Combustion Ignition."

Bell Aircraft Corp. received $115,734 for continuation of "Program of Exploratory Research."

Boston University received $28,343 for research on chemical properties of active nitrogen.

University of Maryland received $32,000 for continuation of research on the theory of scattering.

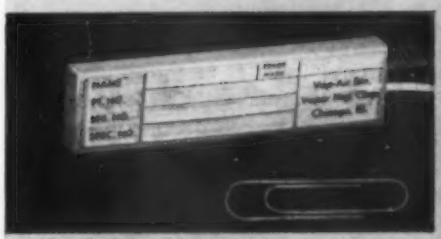
Westvaco Chlor-Alkali Division, Food Machinery and Chemical Corp., received $37,240 for rocket propellant.

American Chain & Cable Co., Inc., American Cable Division, received $28,744 for steel retrieving cable assemblies.

FOR RELIABLE, PRECISION PERFORMANCE IN SURFACE TEMPERATURE SENSING

VAP-AIR MERCURY TUBE THERMOSTATS

TYPICAL HOUSINGS



Flat Surface with Leads. Can operate relays directly without amplification in control application.

Flat Surface with Stud. Senses metal case temperatures in limited regions of limited air flow.

Curved Surface with Studs. Two terminals for continuous series circuit.

Well-Type with Leads. For sensing case temperatures in blind well, or point temperatures.

- Small, rugged, accurate, reliable, safe
- Unaffected by altitude, vibration, shock, moisture
- Adaptable to any temperature sensing need
- Only simple circuits required

VAP-AIR fast-responding merc thermostats are completely reliable from —65°F. to 550°F with accuracy better than 99%. No fire or explosive hazard . . . Mercs are tamper-proof, can't arc or burn, won't rust or corrode.

SYSTEMS ENGINEERING AID

VAP-AIR engineers are specialists in developing and supplying complete systems for thermal sensing and control. Submit your problems for engineering analysis. No obligation.

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Please send Vapor Merc Surface Temperature Sensing Thermostat Bulletin 674.

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Company_____
Street_____
City, Zone, State_____

4 Ounce Contact Force Makes Relays More Reliable

Contact force of 4 ounces per contact on 50 "G" models and 2 ounces per contact on 30 "G" models of "Diamond H" Series R and Series S miniature, hermetically sealed, aircraft type relays is one of the most important factors in their proven high reliability.

Though absolute reliability of any similar device is impossible to guarantee—a bitter fact of life recognized by all electronic engineers—close approach to this goal by the relays manufactured by The Hart Manufacturing Company is the basic reason they are found today on many of this country's headline-making missiles.

In addition to contact force far beyond that found on other relays, "Diamond H" relays have greater contact cleanliness. Self-contamination is virtually eliminated by a completely inorganic switch mechanism, as well as use of coil materials which will not dust, flake or out-gas.

Finally, the high degree of reliability that is designed into these relays is maintained in their manufacture by high quality workmanship and a stringent inspection policy at every stage.

In addition to missiles, and their ground control systems, Series R and S relays are designed for use in jet engine controls, computers, fire control, radar and similar critical applications.

4PDT units, they offer an extremely broad range of performance characteristics, including temperature ranges from —65° C. to 125° and 200° C.; ratings to 10 A., 120 V., A. C., and 26½ V., D. C., with special ratings to 400 ma. at 350 V., D. C., or down to millivolts and milliamperes. Dry and wet circuits may be safely inter-mixed.

For more information, write today for Bulletins R250 and S260. For quick facts about "Diamond H" switches, thermostats and other devices, ask also for a copy of the "Diamond H" Check List of Reliable Controls.

THE HART MANUFACTURING COMPANY

161 Bartholomew Ave., Hartford 1, Conn.
Phone JAckson 5-3491

Circle No. 37 on Subscriber Service Card.

space age

by Norman L. Baker

Aurora borealis blocks missile detection—Radiations of the aurora borealis are proving a tremendous headache to scientists formulating plans for missile defense. Existing radar scopes of the North American Air Defense Command in the Arctic have discovered that the northern lights have, in many instances, rendered radar detection apparatus incapable of operation. A Canadian scientific group plans to send high altitude rockets into the borealis to release chemicals for the study of effects of these impediments to radar and radio operation.

Gamble in lunar probe—Canaveral personnel working on the Air Force's lunar program can't understand why the week proceeding the first attempt was not utilized for two or three dry runs. Trial runs would have eliminated countdown confusion in the race to get the vehicle off the pad at the precise time.

The entire operation was probably lost when the decision was made to gamble with an early loxing operation in a false sense of preparedness.

Liquid rocket engineers place the maximum pre-launching time for loxing a missile at 45 minutes. Confinement of liquid oxygen beyond this time initiates a multitude of problems—metal in contact with the LOX begins to crystallize and valves operate sluggishly or not at all. Heaters can be placed around the valves—and this is usually done.

At launch, when the crystallized metal is subjected to acceleration, vibration and pressure—anything can happen. The tanks or lines can rupture at the seams and joints as was the reported case in the first lunar shot (m/r, Aug. 25, p. 13).

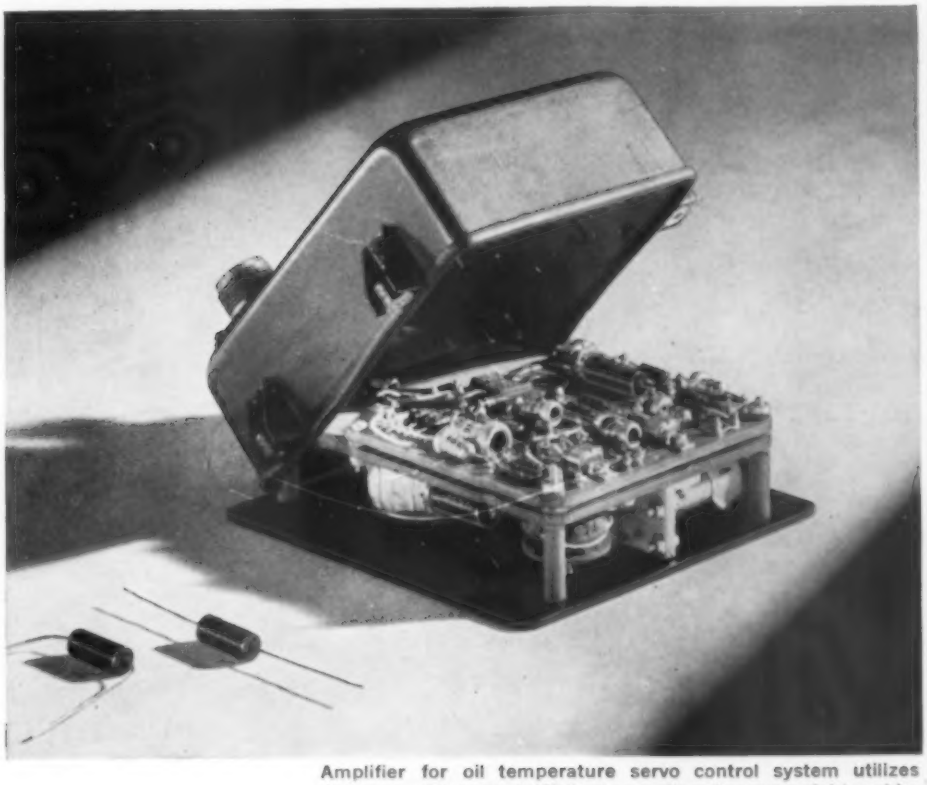
Moon-Sun boomerang—A rocket to the sun with an assist from the moon for probing the solar atmosphere has been suggested by R. P. Haviland of General Electric as a project worthy of consideration during the period of extended IGY activities. By employing a "crack-the-whip" technique effected by the centifugal force generated by the moon in its orbit around the earth, a near approach to the sun would be possible, according to Haviland.

Major holdback—Accurate guidance for bringing the vehicle near enough to the moon to take advantage of the moon's orbital velocity—about 3600 mph—without being pulled into an orbit about the moon or impacting with it. Fifty-pound probes could be sent as far as Mercury, using five-stage vehicles with 250,000-pound take-off weights. Closer approaches would require additional stages or additional take-off weights.

Vanguard **must fire quickly**—Once the *Vanguard* launching vehicle has been fueled up in preparation for firing and then emptied during a hold, a new firing date must be scheduled within a matter of days. The acid oxidizer in the second stage resists complete dilutation during the draining and flushing operation, consequently, a slow deterioration of lines and tanks is soon underway. This was the major factor in setting the second firing date for SLV-3 ten days after the first attempt.

The NRL scientists are not the only people eagerly awaiting a successful launch of a full-size *Vanguard*. Many IGY scientists fully aware of the error probability of the *Explorer*-type of satellite with the attached metal hardware inducing interference, have high hopes for the spherical *Vanguard*.

Airborne Miniaturized Mylar* Capacitors help **reduce weight and bulk** in electronic packages



Amplifier for oil temperature servo control system utilizes Airborne miniaturized "Mylar" capacitors to save weight and insure high reliability. Entire system, including rotary actuator, is Airborne produced and is designed to meet specifications MIL-E-5272A, MIL-E-5400A, etc. Environmental requirements include −65 to +200°F. and up to 60,000 ft. altitude.

Developed originally for motor start and run purposes, Airborne miniaturized "Mylar" capacitors are currently finding increasing application in electronic circuits where small size, light weight, and high reliability are of paramount importance.

Typical of such applications is one of our *own* servo control amplifiers, shown above. Used as a component of an Airborne-designed oil temperature control system for high performance aircraft, the amplifier consists of a .1% precision resistance bridge, stable feedback transistor amplifier, reference oscillator, phase demodulator, and relay output amplifier. Production units employ printed circuitry.

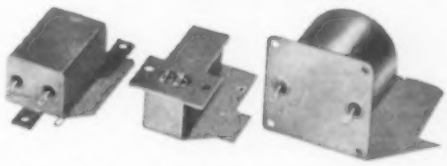
Two of Airborne's miniaturized "Mylar" capacitors are utilized in this particular amplifier — a .1 mfd unit for tuning in the reference oscillator section of the amplifier and a .02 mfd unit for phase shift correction in the stable feedback transistor amplifier section. Capacitors are epoxy encased and are designed to meet or exceed Government specification MIL-C-25A.

Wound of thin metallized "Mylar" film, Airborne miniaturized capacitors are rated up to 600 v d-c, 330 v a-c and have an operating temperature range of −75 to +300°F. At 300°F they will withstand 120% rated voltage for 250 hr.

Write, phone or wire for more information on Airborne special design miniaturized "Mylar" capacitors. Inquiries are also invited on complete electromechanical control systems.

*Du Pont's trademark for its polyester film

TYPICAL SPECIAL CAPACITORS



E-8109 Style E-8104 Style E-8107 Style

CATALOG 57B

Gives detailed information on Airborne special design miniaturized "Mylar" capacitors and Airborne R.F. filters. Write for copy.

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OVER 250 MODELS OF JOY FANS...

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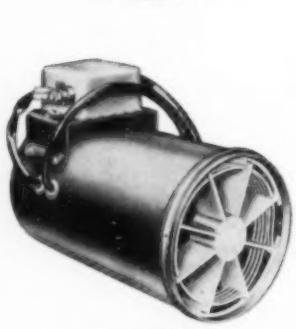

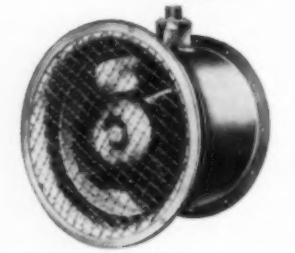

LIGHTWEIGHT because they are made of aluminum or magnesium castings produced in Joy's own foundries.

COMPACT design—with motor mounted inside the fan—permits installation anywhere . . . even inside a duct.

EFFICIENT vaneaxial design provides more air per given size than any other type fan.

AVAILABLE on a production line basis . . . Joy has over 250 standard models with 1300 designs available to your specs . . . from 1/500th horsepower up.

RUGGED because of simple design . . . the outer casing, the vanes and motor mounts are cast in one piece . . . vibration free.

Get more information from the world's largest manufacturer and supplier of vaneaxial fans to companies like G.E., Hallicrafters, Lear, R.C.A., Motorola, Raytheon, Sylvania.

Write to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for FREE Bulletin 135-13A

WSW 16348-135

JOY

WORLD'S LARGEST MANUFACTURER OF VANEAXIAL-TYPE FANS

when and where

OCTOBER

Armour Research Foundation and Illinois Institute of Technology, Annual Noise Abatement Symposium, Hotel Sherman, Chicago, Ill., Oct. 9-10.

Fuels-AIME Conference, American Society of Mechanical Engineers, Old Point Comfort, Va., Oct. 9-10.

14th Annual National Electronics Conference, Hotel Sherman, Chicago, Ill., Oct. 13-15.

ASME, Lubrication-ASLE Conference, Statler Hotel, Los Angeles, Calif., Oct. 14-16.

Association of the United States Army, 1958 annual meeting, Sheraton-Park Hotel, Washington, D.C., Oct. 20-22.

URSI, IRE, USA National Committee Joint Meeting, Pennsylvania State University, University Park, Penna., Oct. 20-22.

IRE, 1958 National Simulation Conference, Professional Group on Electronic Computers, Statler-Hilton Hotel, Dallas, Oct. 23-25.

Fourth Annual Symposium on Aviation Medicine, Miramar Hotel, Santa Monica, Calif., Oct. 22-24.

SAMA Laboratory Apparatus and Optical Sections' Midyear Meeting, Westchester County Club, Rye, N.Y., Oct. 26-28.

Institute of Radio Engineers East Coast Conference, Aeronautical and Navigational Electronics, Lord Baltimore Hotel, Baltimore, Md., Oct. 27-28.

1958 National Metal Exposition and Congress, American Society for Metals, Public Auditorium, Cleveland, Ohio, Oct. 27-31.

IRE, 1958 Electronic Devices Meeting, Shoreham Hotel, Washington, D.C., Oct. 30-31.

NOVEMBER

Fifth Annual Meeting, Institute of Radio Engineers Professional Group on Nuclear Science, Villa Hotel, San Mateo, Calif., Nov. 6-7.

School of Aviation Medicine, International Conference, Physics and Medicine of the Atmosphere and Space, San Antonio, Texas, Nov. 10-12.

Conference on Scientific Information, AFOSR Directorate of Research Communication, NAS, NSF and the American Documentation Institute, Mayflower Hotel, Washington, D.C., Nov. 16-21.

American Rocket Society, 13th Annual Meeting and Astronautical Exposition, Hotel Statler, New York, N.Y., Nov. 17-21.

Circle No. 4 on Subscribers Service Card.

letters

More on Cable

To the Editor:

Re your special report on Wires and Cables: Vital to Missiles (m/r, Sept. 8, p. 23). You are to be commended on the Teflon section of the article. There is no doubt that the added reliability of Teflon-TFE-fluorocarbon resins far outweighs the increased cost of this material for wire and cable insulation.

The section on integrated cable-making does not appear to contribute appreciably to the art of manufacturing cables which has been in existence for many years by established cable manufaturers. The features described in this section of your report may not be available in a number of the make-shift cable machines which have been set up for the manufacture of jacketed harnesses by newcomers in the field.

However, we have several machines which have been in operation for a number of years which are equally adaptable to the manufacture of this type of cable. The ability to do this type of twisting is certainly not limited to one firm.

It would appear that one of the most important requirements, that of the cable jacket to protect these delicate components, is entirely missing in your report. The type of cable generally used in this area should be jacketed with an extruded reinforced neoprene covering so that the finished cable will be able to at least meet the minimum requirements for mechanical abuse and low temperature operation called out in MIL-C-13777A for class C Jacket if proper protection for the twisted complex is to be achieved.

D. C. Alexander
Chief Engineer
Surprenant Mfg. Co.

The examples given in the article were not intended to give the impression that these were the only sources available or capable of filling the needs . . . Ed.

The editors of MISSILES AND ROCKETS welcome contributions from readers in the form of letters. Such contributions often add greatly to the information of other readers about a complex technology and complex business operation. Letters should be addressed: "To the Editor, Missiles and Rockets, 1001 Vermont Ave., N.W., Washington 5, D.C." They should be signed and should include company or other affiliation of the writer. Contributions will be subject to some editing to fit space and style requirements.

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world astronautics

by Frederick C. Durant III

Krafft Ehricke, speaking recently on the problem of accuracy requirements of velocity cut-off in interplanetary journeys, stated that .5 ft/ sec (out of 37,000 ft/sec) was required for Venus; while .02 ft/sec accuracy was required for an un-powered ballistic flight to Mars. However, because of current lack of precise knowledge of the size and density of the planets, even with velocity cut-off of infinite accuracy we wouldn't know now *when* to cut-off!

Plastic models of spacecraft are becoming widely available and grace many professional rocketeers' offices as well as their youngsters' rooms. Easily assembled kits of space stations, lunar vehicles, as well as the X-17 and operational missiles, are marketed by a number of companies. Revell, Inc. of Venice, Cal. (whose models seem the best detailed) distributed hundreds of kits to guests at the National Missile Industry Conference held in Washington. Strombeck-Becker Mfg. Co., Moline, Ill. and Lindberg, Inc. Skokie, Ill. also have spacecraft models. Park Plastics Co., Linden, N.J. has a "pneumatic-hydraulic jet propelled" rocket for the youngster that will zoom to 100 feet.

The Polish Astronautical Society now has 500 members, and two new sections in Bydgoszcz and Lublin. At the elections last spring, Prof. Z. Padzkowski was named president, Prof. Dr. K. Zarankieweicz, vice-president. Active and growing, the Polskie Toworzystwo Astronautyczne (PTA) sections in Krakow and Lublin plan to construct meteorological rockets.

From Germany comes news that a research laboratory has recently been established at Bonn University Observatory to monitor satellite signals. *Sputnik* 3 signals have been received and recorded. Also, August Staats of the Dafra, Bremen, reports that his group will launch a 50 km. altitude sounding rocket soon to obtain meteorological data in connection with IGY activity.

Time moves swiftly. It is interesting to note that President Eisenhower signed the bill forming the NASA on July 29, 1958. This date is exactly three years after his announcement of project *Vanguard*. The next three years may continue this rate of astronautical progress, probably including several successful manned satellite flights.

According to Dr. O. Wolczek, of the Nuclear Research Institute, Wausau, a 20 metagon hydrogen bomb exploded sixty million miles in space would produce a light of equivalent brightness of venus. Wolczek believes that such an experiment would provide valuable data to astrophysicists in simulating natures method of forming stars. Data might be obtained through the use of unmanned space observation craft.

On the occasion of the 25th anniversary of the British Interplanetary Society, a symposium on space medicine will be held in London, October 16-17. Cdr. George W. Hoover, USR, sparkplug of Project Orbiter, will speak on the "Man-Machine System in Space Vehicles."

Office of Technical Services (US Dept of Commerce) plans to publish an English translation of Alexander Sternfeld's 433 page book, "Artificial Satellites." Price will be six dollars. Sternfeld is a well known, semi-popular writer and long time promotor of Astronautics in the USSR.

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C. A. Besio
Supervisor, Engineering Personnel
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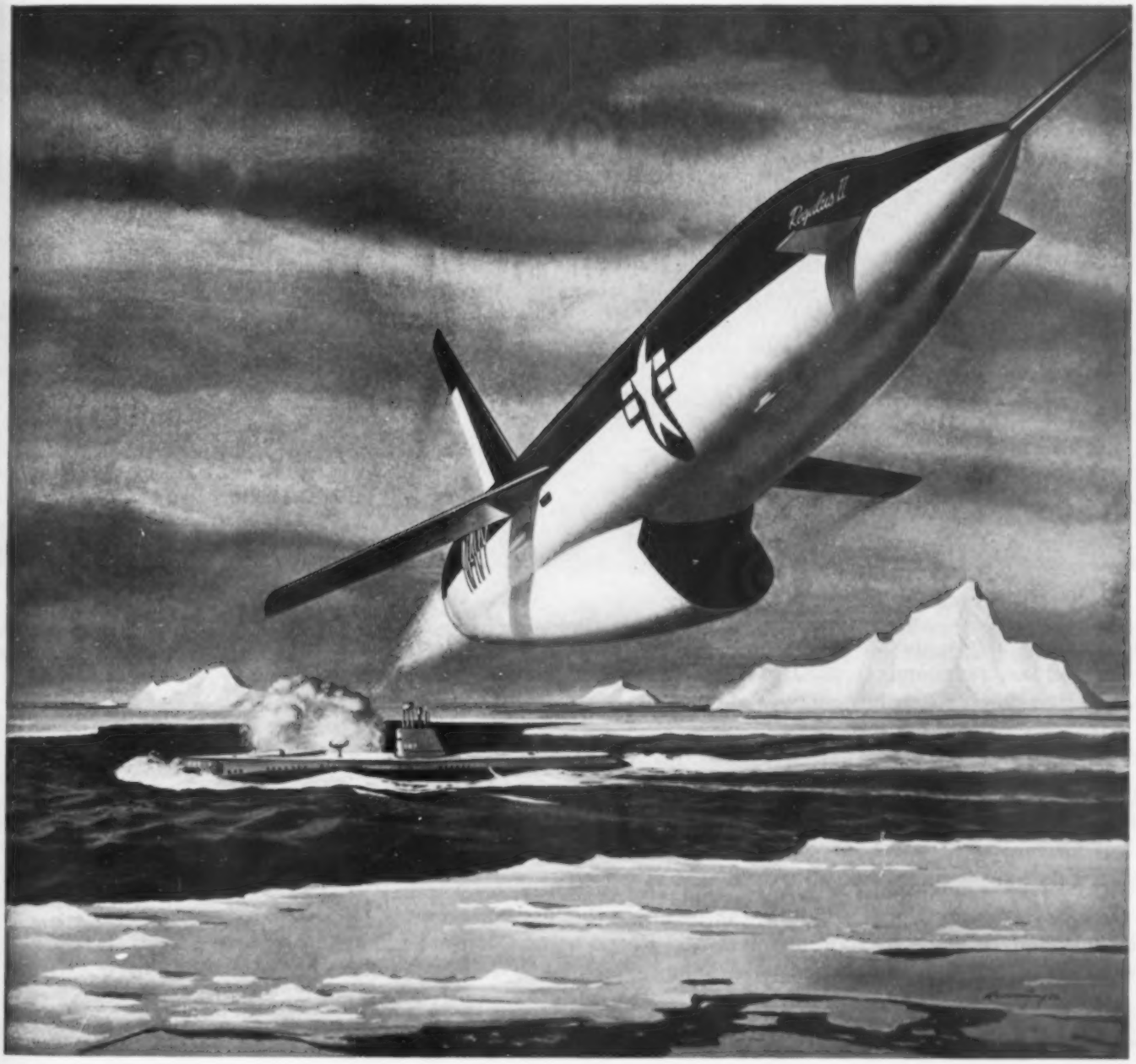

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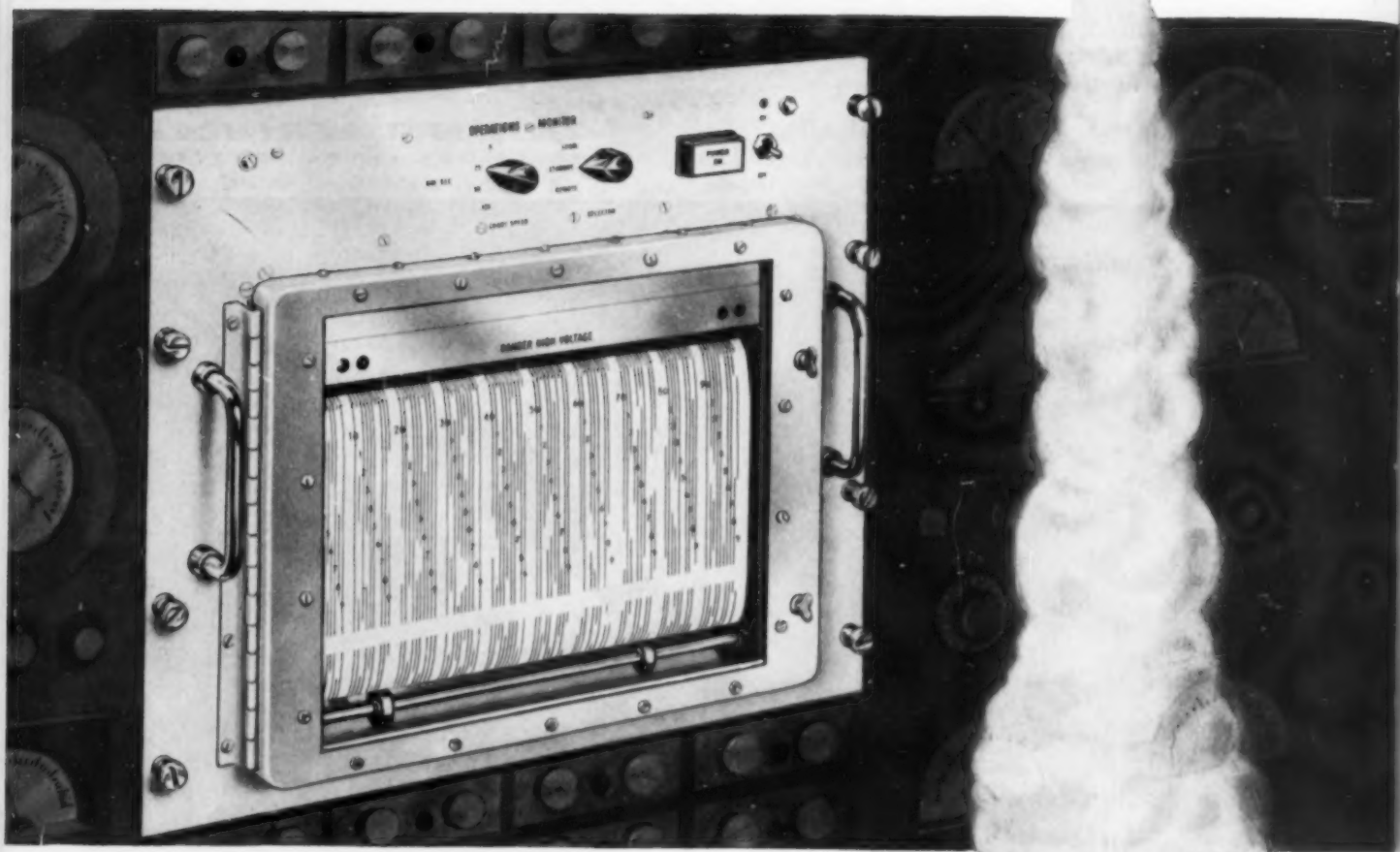

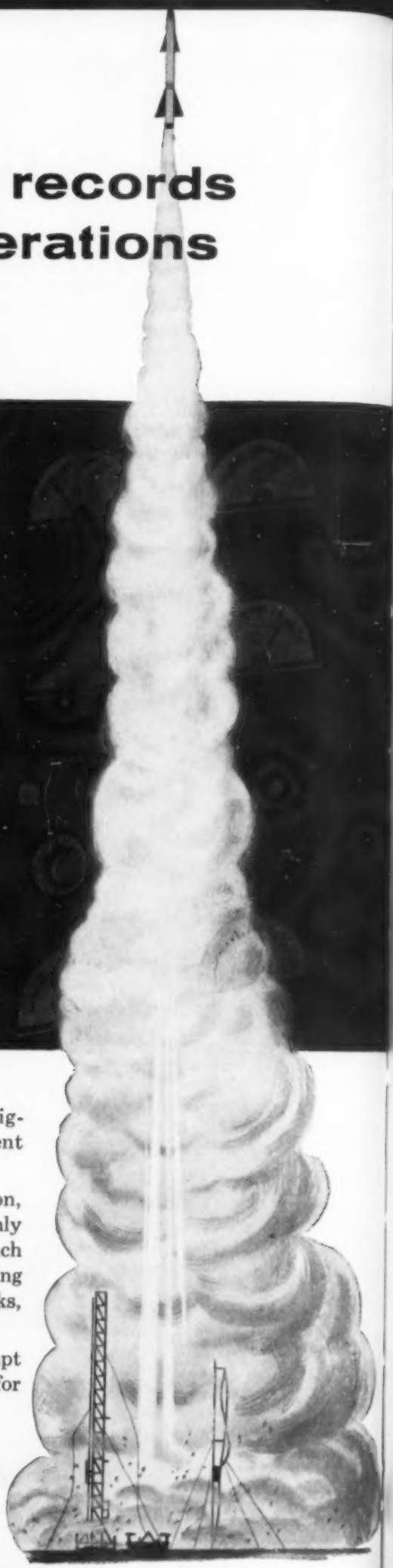

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book reviews

PRINCIPLES AND APPLICATIONS OF RANDOM NOISE THEORY by Julius S. Bendat, 431 pp, $11, John Wiley & Sons, N.Y.

This study, written by a senior staff member of the Ramo-Wooldridge Corp., will be of interest to those in the fields of statistical communication theory, systems analysis, automatic control, meteorology, aeronautics, radar, product testing, and other related studies.

Principles of random noise analysis and optimum filtering techniques are explained, with emphasis on physical meanings and mathematical restrictions. The author shows how to formulate difficult noise problems, how to solve them mathematically and how to draw appropriate physical designs and interpretations.

Other areas covered by Dr. Bendat include the Zero-Crossing problem, statistical errors in correlation measurements, advanced optimum time-variable designs and methods of analog computer simulation for noise problems.

HANDBOOK OF PHYSICS, edited by E. U. Condon and Hugh Odishaw, McGraw-Hill, New York, New York, 1504 pp., $25.

A comprehensive and authoritative guide to basic physics, it deals with the principles, ideas, concepts and advanced mathematical methods of all branches of classical and modern physics.

The emphasis is on the principles of physics and the mathematical techniques required for their exposition. Within this framework, the main sections cover mathematics, mechanics of particles and rigid bodies, mechanics of deformable bodies, electricity and magnetism, heat and thermodynamics, optics, atomic physics, physics of the solid state, and an analysis of nuclear physics.

1957 VACUUM SYMPOSIUM TRANSACTIONS; American Vacuum Society, 176 pp., $12.50, Pergamon Press, New York.

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Moscow briefs

The U.S. Army's surface-to-air guided missile *Hawk* is the subject of particular Soviet attention in recent weeks. This is evidenced by the lengthy article in SOVETSKAYA AVIATSIA of August 15 on American, French, and other Western defenses against low-flying craft. The author, Lieutenant Colonel B. Surikov of the Soviet engineering forces, uses an official U.S. Army photograph of the *Hawk* as his article's only illustration.

He devotes nearly one-half of his text to the *Hawk*. After listing, from U.S. and other Western sources, all the available data on the *Hawk's* range, frame, guidance, and power plants, the Soviet officer cites all the pros and cons usually advanced by the non-Soviet admirers and detractors of the *Hawk*. However he extends more of his space and support to the criticism of the *Hawk* than to the praise of it.

Discussing Soviet ideas on the future rocket-plane and its gliding feature, Professor V. S. Pyshnov remarks in SOVETSKAYA AVIATSIA: "It turns out that even a glider, which has always been a synonym for a slow-motion flying apparatus, can, in the future, compete with a ballistic rocket. Give it great speed initially—and it will glide pretty much around the globe."

"Soon the first interplanetary flights will be a reality, even before the majority of you finish your schooling." So wrote Professor N. A. Varvarov in KOMSOMLSKAYA PRAVDA, on August 31, in his greetings to Soviet teenagers on the eve of the opening of the new 1958-59 school year. A prominent astrophysicist, Dr. Varvarov is chairman of the Astronautics Section of DOSAAF. (These initials stand for the Russian name of the Volunteer Organization of Aiding the Army, the Air Force, and the Navy of the Soviet Union, the civil-defense apparatus of that country.) His greetings were headlined: "You Are Destined to Discover Other Planets."

Russia's oldest astrobotanist, Professor G. Tikhov, claims that astrobotany was born in Russia in 1946, at the Alma-Ata astronomical observatory in the Soviet Kazakhstan, Central Asia. Writing in KOMSOMOLSKAYA PRAVDA, Dr. Tikhov again insists that there is vegetation on Mars and that by now Soviet and other astrobotanists "have established certain characteristics of Martian plants."

The work of his Alma-Ata laboratory (attached to the observatory) has led to "an opportunity to study the

outer-space life, not of vegetation alone, but also of micro-organisms." He declares: "Thus, astrobotany has grown into astrobiology."

He states his belief that beginnings of life are possible, not only on Mars, but also on Jupiter, Saturn, Uran, and Neptune, despite their extremely low temperatures. He argues that not even extremely low temperatures can prevent certain rudimentary forms of life from arising. "Our study of microorganisms on these giant faraway planets will allow us to penetrate the mystery of life's beginning, by far not yet clear to our contemporary science," he said.

The dynamics of the orbiting of an earth satellite in relation to its own center of gravity is among the subjects absorbing the attention of Professor Leonid Sedov. In a recent paper on this topic, the top-rank Soviet astrophysicist stated that this dependence noticeably affects the magnitude of air resistance encountered by the satellite.

This influence must be taken into consideration in various scientific appraisals of the satellite-yielded data, such as in research having to do with ascertaining the density of the upper atmosphere. Professor Sedov reveals that *Sputnik* III, on reaching the lowest part of its orbit and passing through the upper atmosphere, "is decelerated with the force of nearly four grams."

Scorn for nonpatriotic Russian detractors of the three *Sputniks* is expressed by Vasily Ardamatsky in LITERATURNAYA GAZETA. According to Ardamatsky, some Russian grumblers would rather stop in the streets of Moscow to admire a parked foreign "fish-shaped" automobile with a fancy diplomatic license plate than boast of his native *Sputniks*. A goodnatured reminder by a patriotic passerby to the unpatriotic car-admirer is quoted in the article: "Don't forget our *Sputnik!*" But the renegade Russian replies scornfully: "Let others fly in it—those with their higher educations."

The unpatriotic Russian is also shown by the author as complaining about too many Russian automobiles being ridden by "too many academicians"—his dig at the Soviet astrophysicists and rocket experts with their privileged status. The "traitor" is also accused by the Soviet journalist of dismissing his government's proud tales of *Sputnik* III with a bored and cynical "So what?"

Instead of applauding the *Sputnik*, the "traitor" is busily spreading somebody's "sticky fables, from Dulles' best dreams, that in America they have allegedly sent a rocket to the Moon and that television programs are being broadcast from there." Comrade Ardamatsky broadly hints that the Soviet government should do something about such disorderly disloyalty.

Swifter speeds for *Sputniks* are revealed by the Moscow authorities. It is announced that after the first 1,000 round trips *Sputnik* I circled our globe in 3.5 minutes less, *Sputnik* II in 3.9 minutes less, and *Sputnik* III in 0.85 minute less. The initial orbit time was 96.2 minutes for *Sputnik* I; 103.7 minutes for *Sputnik* II; and 106 minutes for *Sputnik* III.

Soviet praise for Czechoslovak observation of earth-satellites was officially voiced in Moscow. The results of optical observation made at the observatory at Skalnaté Pleso in Slovakia were highly rated. Dr. Emil Buchar, a Czech scientist, announced that on the basis of Czechoslovak observations he had deduced a much more exact calculation of the deformation of the earth's sphere than was available.

Dr. Vladimir Guth, of the Slovak Academy of Sciences, is continuing his research on the content of cosmic dust.

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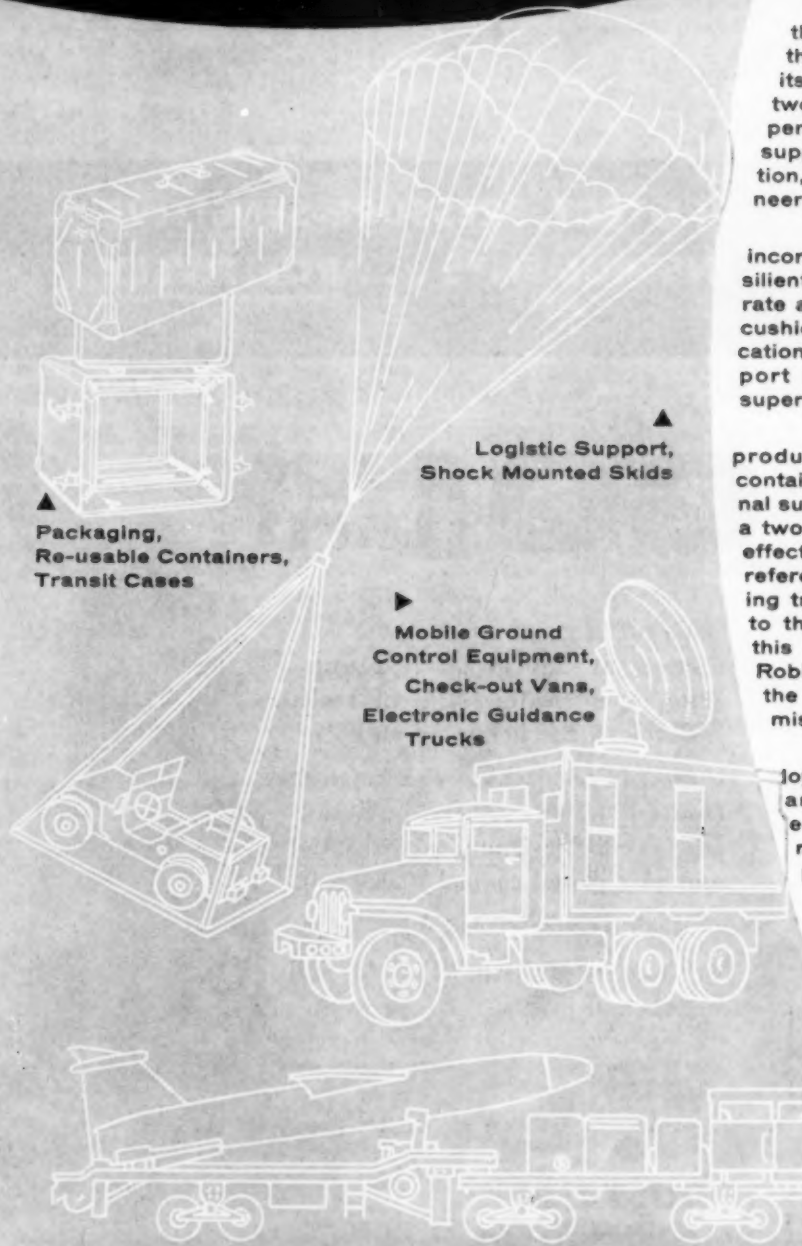

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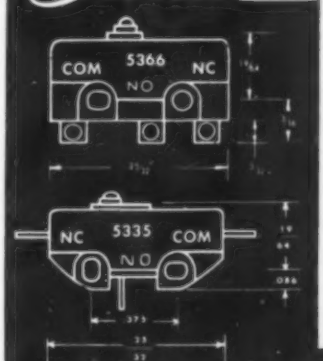

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